# PROCEEDINGS

OF THE

# MADRAS GOVERNMENT

IN THE

# PUBLIC WORKS DEPARTMENT

## IRRIGATION BRANCH,

FOR THE

## MONTH OF JUNE 1909.

*Printed by Authority.*

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| Forwarded ... ... ... ... ... ... | 29th do. do. No. $\frac{276}{A}$ I. | ...... |
| *Special Revenue Officer, Kistna Reservoir Project.*—Fixing Guntúr as the head-quarters of the — and stating that, for the purpose of drawing bills, he should be treated as an officer of the Public Works Department and allowing him an imprest of Rs. 135. | 29th do. do. No. 277 I. | 15th April 1909, No. 166 I. |
| *Iron punts for the Gódávari Northern division.*—An estimate, amounting to Rs. 58,500, for constructing ten — sanctioned. | 29th do. do. No. $\frac{277}{A}$ I. | ...... |
| *Bridges over the Ellore and Ryres' canals at Bezwada.*—Directing, with remarks, the Superintending Engineer, II Circle, to arrange a conference at which the Collector of Kistna, the Chairman of the Bezwada Municipal Council and the Agent of the Madras and Southern Mahratta Railway Company shall be represented to consider the question of the adequacy of the proposals of the Railway Company in regard to the construction of new —. | 30th do. do. No. 278 I. | ...... |

# GOVERNMENT OF MADRAS.

## PUBLIC WORKS DEPARTMENT.

## TABULAR STATEMENT OF MISCELLANEOUS PROCEEDINGS,

### IRRIGATION.

### FOR THE MONTH OF JUNE 1909.

| Subject. | Number and Date of Order. | Numbers and Dates of previous Orders. |
|---|---|---|
| *Quarters of the Peravalli Lock Establishment, Gódávari Western division.*—Approving with remarks the estimate of Rs. 385 for the construction of compound walls to the —. | 16th June 1909, No. 260 I. | ...... |
| *Civil suits.*—Sanctioning the payment of Rs. 11-15-0 incurred on account of — filed for the recovery of the rent due from certain individuals on the lease of cocoanut trees situated on the banks of the Bendamurlanka canal and Vainiteyam left bank in the Gódávari Eastern division. | 16th do. do. No. 261 I. | 20th Nov. 1906, No. 1152 I. |

# GOVERNMENT OF MADRAS.

# PUBLIC WORKS DEPARTMENT.

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## TABULAR STATEMENT OF MATTERS OF ROUTINE,

### IRRIGATION,

### FOR THE MONTH OF JUNE 1909.

| Subjects. | Number and Date of Order. | Numbers and Dates of previous Orders. |
|---|---|---|
| *Letter of credit.*—Authorising the Examiner, Public Works Accounts, to issue a — to the Executive Engineer, Cauvery Division, pending the provision of funds required. | 1st June 1909, R. No. 259 I. | ...... |
| *Land.*—Directing the publication in the *Fort St. George Gazette* of a notification for the acquisition of — required for cutting a new channel in the Srinivasapuram village, Saidapet taluk, Chingleput district. | 1st do. do. R. No. 260 I. | ...... |
| *Land.*—Directing the publication in the *Fort St. George Gazette* of a notification for the acquisition of — required for the improvement of the Manjaneer channel in Conjeeveram taluk, Chingleput district. | 1st do. do. R. No. 261 I. | ...... |
| *Land.*—Directing the publication in the *Fort St. George Gazette* of a notification for the acquisition of — required for repairs to Gangaperur tank, Sidhout taluk, Cuddapah district. | 3rd do. do. R. No. 262 I. | ...... |
| *Land.*—Directing the publication in the *Fort St. George Gazette* of a notification for the acquisition of — required for raising and strengthening the flood banks of the Ponniar river in Payithambadi village, Cuddalore taluk, South Arcot district. | 3rd do. do. R. No. 263 I. | ...... |
| *Land.*—Directing the publication in the *Fort St. George Gazette* of a notification for the acquisition of — required for repairing the Vadanur tank in Mattur village, Villupuram taluk, South Arcot district. | 5th do. do. R. No. 264 I. | ...... |
| *Land.*—Directing the publication in the *Fort St. George Gazette* of a notification for the acquisition of — required for the improvement of Kilakkupandal tank and the temporary occupation and use of the — in Polur taluk, North Arcot district. | 5th do. do. R. No. 265 I. | ...... |
| *Land.*—Directing the publication in the *Fort St. George Gazette* of a notification for the acquisition of — required for improving the Budarayanpettai branch of the Manambattan channel, Chidambaram taluk, South Arcot district. | 5th do. do. R. No. 266 I. | ...... |

| Subject. | Number and Date of Order. | Numbers and Dates of previous Orders. |
|---|---|---|
| *Land.*—Directing the publication in the *Fort St. George Gazette* of a notification for the acquisition of — required for improving the irrigation channel from the low level sluice of Mahendravadi tank, Wallajah taluk, North Arcot district. | 5th June 1909, R. No. 267 I. | ... |
| *Irregular expenditure.*—Authorising the Examiner, Public Works Accounts, to pass the — incurred on account of establishment in Cauvery and Kistna Reservoir Projects. | 7th do. do. R. No. 268 I. | 5th Mar. 1909, No. 105 I. |
| *Kistna Reservoir Project.*—Ordered that a letter to the Honourable the Resident at Hyderabad be sent requesting an early supply of certain maps of His Highness the Nizam's territory for use in connection with the investigation of the —. | 8th do. do. R. No. 269 I. | 15th Mar. 1909, Nos. 147–148 I. |
| Letter to the Honourable the Resident at Hyderabad. | 8th do. do. R. No. 270 I. | ...... |
| *Land.*—Directing the temporary occupation and use of the — required for raising the Gódávari right flood bank in Yenuguvanilanka and Chinchinada villages, Narsapur taluk, Kistna district. | 10th do. do. R. No. 271 I. | ...... |
| *Land.*—Directing the publication in the *Fort St. George Gazette* of a notification for the acquisition of — required for a field channel at Potlapudi, Nellore district. | 10th do. do. R. No. 272 I. | ...... |
| *Land.*—Directing the publication in the *Fort St. George Gazette* of a notification for the acquisition of — required for the diversion of the Siruvanur channel in Sirumadurai village, Tirukkóyilúr taluk, South Arcot district. | 10th do. do. R. No. 273 I. | ...... |
| *Land.*—Directing the publication in the *Fort St. George Gazette* of a notification for the acquisition of — required for a drainage channel in connection with the repairs to Periyár main canal No. 1 section, Madura district. | 11th do. do. R. No. 274 I. | ...... |
| *Irrigation Administration Report of the United Provinces.*—Letter from the Government of United Provinces, Public Works Department, Irrigation Branch, forwarding copies of the — for the year ending 31st March 1908, recorded. | 15th do. do. R. No. 275 I. | ...... |
| *Land.*—Directing the publication in the *Fort St. George Gazette* of a notification for the acquisition of — required for the diversion of Vasista left bank at Sakhenetipalli set in Nagaram taluk, Gódávari district. | 15th do. do. R. No. 276 I. | ...... |
| *Erratum.*—Directing the publication in the *Fort St. George Gazette* of an — to the notification of 3rd April 1909 regarding the acquisition of land in the village of T. Attipakkam, Tirukkóyilúr taluk, South Arcot district. | 15th do. do. R. No. 277 I. | ...... |
| *Railway and Canal map of India.*—Ordered that a reply be sent to the Assistant Surveyor-General acknowledging receipt of four sets of the —. | 16th do. do. R. No. 278 I. | ...... |
| Letter to the Assistant Surveyor-General, Calcutta. | 16th do. do. R. No. 279 I. | ...... |

| Subject. | Number and Date of Order. | Numbers and Dates of previous Orders. |
|---|---|---|
| *Land.*—Directing the publication in the *Fort St. George Gazette* of notification for the acquisition of — required for the extension of the bund of, and construction of a weir to, the Kolappapattu tank, Tiruvannámalai taluk, South Arcot district. | 16th June 1909, R. No. 280 I. | ...... |
| *Land.*—Directing the publication in the *Fort St. George Gazette* of a notification for the acquisition of — required for Pallur Chitteri channel, Wallaja taluk, North Arcot district. | 16th do. do. R. No. 281 I. | ...... |
| *Land.*—Directing the publication in the *Fort St. George Gazette* of a notification for the acquistion of — required for the surplus of the Pinnepalli tank in Yadiki village, Tadpatri taluk, Anantapur district. | 16th do. do. R. No. 282 I. | ...... |
| *Land.*—Directing the publication in the *Fort St. George Gazette* of a notification for the acquisition of — required for the excavation of a field channel in Peteru village, Tenali taluk, Guntúr district. | 16th do. do. R. No. 283 I. | ...... |
| *Land.*—Directing the publication in the *Fort St. George Gazette* of a notification for the acquisition of — required for repairs to Ferangikhan Codu channels, Bhimavaram taluk, Kistna district. | 16th do. do. R. No. 284 I. | ...... |
| *Land.*—Directing the publication in the *Fort St. George Gazette* of two notifications for the acquisition of — required for the diversion of the Nandur supply channel in Bapatla taluk, Guntúr district. | 17th do. do. R. No. 285 I. | ...... |
| *Land.*—Directing the publication in the *Fort St. George Gazette* of a notification for the acquisition of — required for a field channel in Mannadimangalam village, Madura district. | 19th do. do R. No. 286 I. | ...... |
| *Land.*—Directing the publication in the *Fort St. George Gazette* of a notification for the acquisition of — required for the improvement of supply channel to Andalur Eri in Polur taluk, North Arcot district. | 22nd do. do. R. No 287 I. | ...... |
| *Land.*—Directing the publication in the *Fort St. George Gazette* of a notification for the acquisition of — required for depositing earth from the high banks of Chopella side channel, Rámachandrapuram taluk, Gódávari district. | 22nd do. do. R. No. 288 I. | ...... |
| *Divi Island Pumping scheme.*—Ordered that a reply be sent to Mr. J. Montrion Campion, London, forwarding copies of certain Government Orders on the subject of the —. | 22nd do. do. R. No. 289 I. | ...... |
| *Excess outlay.*—Authorising, with remarks, the Examiner, Public Works Accounts, to pass the — of Rupees 637 incurred in connection with reinvestigation of the Kistna Reservoir project. | 29th do. do. R. No. 290 I. | ...... |
| *Excess expenditure.*—Office-note from the Examiner, Public Works Accounts, stating that an — of Rupees 6,991 was incurred in Madura division for Berijam project up to the end of April 1909, communicated with remarks to the Superintending Engineer, VI Circle. | 29th do. do. R. No. 291 I. | ...... |

# Government of Madras.

## PUBLIC WORKS DEPARTMENT.

IRRIGATION.

| | | | |
|---|---|---|---|
| *Recd.* | } 1909. | *Enclosures* | |
| *Regd.* | | *Spare copies* | |

## G.O., No. 229 I., 2nd June 1909.

### Silting up of the Kistna Reservoir.

Communicating, with remarks, to the officers concerned letter from the Government of India forwarding for consideration a note by the Inspector-General of Irrigation regarding the —.

GOVERNMENT OF MADRAS.

PUBLIC WORKS DEPARTMENT.

**Irrigation.**

Read—the following papers :—

I

**G.O., No. 200 I., dated 8th May 1909.**

Abstract.—Communicating to the Superintending Engineer on Special duty for information and guidance letter from the Government of India forwarding copy of a note by the Inspector-General of Irrigation on the proposed Kistna Reservoir Project.

II

*Letter*—from Lieut.-Col. W. M. Ellis, R.E., Superintending Engineer on Special duty.
*To*—the Chief Engineer for Irrigation.
*Dated*—Bezwada, the 27th March 1909.
*No.*—113 I.

I forward a rough draft of my note on silt in the Kistna for your perusal.

I send this and the tables, in original, in view of the urgency of the matter and the fact that owing to the move of my office from Bezwada to Madras, it would take several days to get this copied.

I would ask either copies be made in your office or the originals sent me for copy.

Enclosures.

*Notes on silt discharged by Kistna river.*

The question of the silt carried in suspension by the Kistna river was raised by the Inspector-General for Irrigation in Madras in March 1909 in connection with the Kistna Reservoir Project.

By a computation assuming that a centage of ·05 by volume of the discharge of the Kistna was deposited yearly in the form of silt in the proposed reservoir, it was shown that the matter was one to be carefully gone into.

It was within my recollection that a series of silt measurements had been taken at Bezwada some eight to ten years ago and the records of these have now been carefully gone into and the results and nature of the information available is treated of in this note.

2. The measurements of silt in suspension were practically confined to the water after entering the canals (Eastern delta) and a series of regular observations were made for the years 1898, 1899, 1900, and for June and July 1901 when the observations were unfortunately discontinued. The nature of the observations taken in 1898 is clearly described in a note, dated 31st March 1899, by Mr. J. S. Wilson, a copy of which is attached.

3. Briefly the method of observations in 1898 was as under :—

A site in the centre of the main canal some 200 feet below the bridge which used to stand in the site of the present head sluice, was selected. Here samples of silt were taken at different depths by lowering a bamboo to the bottom with five corked bottles (quart bottles of capacity about 1½ pints) attached at intervals, the top of the lowest bottle being 1 foot above canal bed. On reaching the bottom, the corks were withdrawn from the bottles by strings and the silty water at various depths filled the bottles. The bottles were raised and corked up, each bottle was then shaken and any excess water drawn off to a mark indicating a certain known capacity (Twenty

ounces Apothecaries' weight, each ounce being 480 grains). About 1 grain of alum was added to each bottle which was left 24 hours to stand. The clear water was then syphoned off. The wet silt was poured into a copper pan and evaporated to dryness and weighed. The sum of all the weights gave the number of grains of silt in five bottles capacity and from this the number of lbs. per c.ft. of silt was computed.

Observations were taken every three or four days and the exact dates and results are all noted in the silt register which has been examined by me.

4. Similar observations were taken in subsequent years with the following minor deviations:—

(*a*) Observations were taken daily during the silt-carrying period.

(*b*) A small chemical balance was used in place of the medicine scales used the first year.

(*c*) The contents of the bottles of silt taken at various depths were mixed before separating out and weighing the silt, so that the silt, carried at different depths was not measured separately after 1898.

(*d*) Certain further observations of quantities of heavy (muddy settling) sands in the silt were made and recorded, but these do not affect the total quantities of silt now being reported on.

5. Inaccuracies in the results may have occurred from the primitive character of the apparatus and in the first year (1898), through taking observations at intervals of three or four days.

Also the measurements of the quantity of water in each bottle might be three or four per cent. in error, as the file marks on the bottles were in the big part of the bottle.

An ascertained error was in counting 44 bottles to the cubic foot, whereas by actual measurement 45 bottles filled up to the mark were required to fill a cubic foot measure. By calculation I find the number of bottles required (20 oz. Apothecaries' weight) to fill a content of 1 cubic foot, is 45·41 bottles. This introduces an error of about $2\frac{1}{4}$ per cent. and to eliminate this $2\frac{1}{4}$ per cent. should be added to the total quantity of silt given in the attached tables. I have not altered the registers as our errors of observation will probably be much more than this, and all that is put forward is that these observations give valuable and reliable results and the limit of error probably does not exceed 12 per cent.

6. Tables have now been computed of the weight of silt discharged by Kistna water in suspension at Bezwada on the following assumptions:—

(*a*) The weight of silt in suspension in the river per c.ft. of discharge was the same as found per c.ft. in the main canal on the same day, and the total daily discharge of silt is the discharge of Kistna multiplied by the observed weight of silt per c.ft. for that day.

(*b*) That in 1898 the weight of silt between days of observation alters proportionately for the period between observations.

These tables are enclosed.

They refer to the under-noted periods:—

1898 from 22nd June to 30th November.
1899 „ 22nd „ to 30th „
1900 „ 22nd „ to 30th „
1901 „ 22nd „ to 31st July.

7. To find the volume of silt in suspension, it is necessary to know the specific gravity of the aggregate total of silt.

Observations on this appear to have been rather rough and the following note is found in the test book:—

(i) Silt brick for 1898–1899.
Measured 22·684 c. inches, weighed 10,831 grains.
1 c. ft. weighs 117·87.

(ii) Silt brick for 1899–1900 measuring 30·468 c. inches, weighs 15,140 grains.
1 c. ft. weighs 122·66 lbs.

(iii) Silt brick for 1900–1901.
Brick measures $7\frac{3}{16}'' \times 4'' \times 1\frac{9}{16}'' = 44{\cdot}92187$ c. inches, weighs 17,752 grains.
1 c. ft. weighs 97·58 lbs.

It is believed bricks were made at the end of each season by drying and compressing the actual silt removed from the water which was stored and the above is the result.

8. The results above gives a very high specific gravity and I have used them in my tables. By considering the volume of silt on the supposition that 1,000 lbs. = 1 c. ft., a fair idea of the quantity of silt will be obtained and this can be done without calculation from the results given in millions of lbs. The results show that on these data the amount of silt to be expected in a reservoir in the main river Kistna, is likely to be far in excess of the tentative figures adopted for computation in Madras which totalled to 1·26 thousand millions c. ft. per year.

9. I have attached a note drawn up in Madras on working of Pulichintala reservoir on the supposition that the silt deposited annually was 1·26 thousand millions c.ft.

*Note on Silting, Kistna Reservoir.*

The capacity of the proposed Kistna Reservoir (Pulichintala site) at + 132, is 150,000 millions c.ft. The required effective capacity for upland canal irrigation is 100,000 millions c.ft. The capacity at cill upland canal is about 50,000 millions c.ft.

The average annual discharge of Kistna, years 1888 to 1907, at Bezwada is as follows :—

| | Thousand millions c.ft. |
|---|---|
| June ... | 136·99 |
| July ... | 712·78 |
| August ... | 841·87 |
| September ... | 494·32 |
| October ... | 334·86 |
| Total ... | 2,520·83 |

Supposing silt is carried in suspension $\frac{1}{2000}$ of water and all deposited in the river during months June to October only.

The annual content of silt deposited would be $\frac{2520}{2000}$ = 1·26 thousand millions c.ft.

An assumption is here made that of all the silt deposited, $\frac{2}{3}$ will be deposited in the first instance below effective supply level upland canal. Silt deposited below this level will not affect effective capacity materially.

The number of years which will run in order to fill up reservoir to level, this level which connotes a capacity of 50,000 millions c.ft., is $\frac{50 \times 3}{2 \times 1{\cdot}26}$, = 59·5 or say 60 years.

Effective capacity of the reservoir will in this 60 years be reduced by $\frac{60 \times 1{\cdot}26}{3}$ = 25·2 thousand millions c. ft.

or say to efficiency 75 per cent.

This diminution of efficiency will probably be rather more rapid in the later years, but may be assumed to be equally spread over the period at 4·2 per cent. every 10 years as below :—

*Efficiency (per cent.).*

| 1st year. | 10th year. | 20th year. | 30th year. | 40th year. | 50th year. | 60th year. |
|---|---|---|---|---|---|---|
| 100 | .. | .. | 92½ | 90 | .. | .. |
| 100 | 95·8 | 91·6 | 87·4 | 83·2 | 79·0 | 74·8 |

After 60 years the effective capacity will be reduced at much greater speed as below :—

| 65th year. | 70th year. | 75th year. | 80th year. |
|---|---|---|---|
| 68·5 | 62·2 | 55·9 | 49·3 |

If the reservoir capacity were increased after 60 years by 33,000 millions c.ft., the reservoir would then work with a loss of capacity from this time of 1·26 yearly, that is, in 26 years, effective capacity would be 75 per cent.

As originally designed for the rough preliminary estimate with F.T.L. + 122, the dam is proposed to be capable of safely filling up to 10 ft. higher to which level the solid dam and roadway is carried.

The capacity at this level is roughly 183 thousand millions c.ft. Thus, if the reservoir F.T.L. after about 60 years were raised by 10 ft., the reservoir will maintain efficiency never less than 75 per cent. up to 85 years.

A further raising of 10 ft. would give probably a further lease of life of 28 years, but would entail a dam 160 ft. high.

It may be noted that except in 1899–1900, the worst year on record, the working tables 75 per cent. of effective capacity, would have brought both first and second crops through without failure from years 1893 to 1905–1906 inclusive. This includes second crop upland canal.

10. The tables now drawn up and based on the silt experiments at Bezwada of 1898 to 1901, give a very different and much less favourable aspect to affairs than the above note. The average annual silt deposits for the years 1898 and 1901 is 4·37 thousand millions c.ft.

(*Note.*—The year 1899 is neglected as abnormal being the worst irrigation year of which we have record, but the silt deposit even in that year is 3·64 thousand millions c. ft.).

This is computed on the assumption that 1 c.ft. of silt weighs 100 lbs.

Taking the assumption of the previous note as regards the distribution of silting over effective and non-effective capacity areas, number of years in which reservoir will silt up to level necessary to give full supply to upland canal, is $\frac{50 \times 3}{2 \times 4 \cdot 37} = 17 \cdot 2$ years.

During this period, the effective capacity of the reservoir would have reduced by 25 thousand millions and it would then be of 75 per cent. capacity. Under such a condition it would clearly be necessary to make the reservoir larger in the first instance, say, 10 ft. higher or with F.T.L. + 132 M.S.L. and total capacity 183,000 million and effective capacity 133,000 million. It would also be made capable of being raised by 10 ft. giving a further capacity of, say, 40,000 million or a total effective capacity of 173,000 million c.ft. Let it be assumed that the reservoir can supply with reasonable efficiency, till effective capacity is reduced to 75,000 million.

Then, if period of effective life of reservoir with F.T.L. + 132 M.S.L. is $(y + 17)$ years, then—

$(y \times 4 \cdot 37) + 75 = 133 - 25.$
$4 \cdot 37\, y = 108 - 75.$
$y = 33/4 \cdot 37 = 7 \cdot 5$ years.
Total life $17 + 7 \cdot 5 = 24\frac{1}{2}$ years.

Raising to + 142 M.S.L. would give further effective life of about 9 years or total 33 years.

11. From the above, it will be quite clear that either—

(*a*) the silt data assumed must be proved grossly erroneous,

(*b*) some thoroughly efficient system of scouring or impounding so as to exclude silt, must be adopted, or

(*c*) the construction of a dam on the main Kistna at any site with a view to efficient storage of large quantities of water, must be abandoned.

12. The above points to be imperative necessity of instituting, during the coming flood season commencing in June, silt observation in the river Kistna and proposals for this will be put forward in a separate note at a very early date.

*27th March* 1909. W. M. ELLIS, Lieut.-Col., R.E.

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*Letter*—from J. S. WILSON, Esq., Executive Engineer, Kistna Eastern division.
*To*—the Superintending Engineer, II Circle.
*Dated*—Bezwada, the 31st March 1899.
*No.*—873-S.E.

With reference to your No. 87-K.E., dated 24th January 1899, forwarding memorandum from the Chief Engineer for Irrigation on the silt measurements carried out here, I have the honour to report as follows.

2. The experiments were started originally with the view of ascertaining roughly the amount of silt carried by the canals during the flood season, and whether it would be possible with the establishment available, to carry out the work with reasonable accuracy. The work done consisted of—

(1) The measurement of the silt in suspension in the water.
(2) The taking of cross-sections of the canals at fixed intervals.
(3) The velocity measurements in the canals.

3. The measurement of the silt in suspension was carried out with my rough apparatus, viz., a series of bottles fixed to bamboos at definite distances apart and arranged to be opened from the surface.

4. The observations at first were taken every fourth day, but later at somewhat irregular intervals, which varied with the state of the river.

5. Samples of the water from different depths at two sites were taken, the sites being
(1) at about 200 ft. below the bridge at the head of the canal;
(2) about 1 furlong below the head of the Masulipatam canal;
At both sites, the samples were taken in the centre of the canal.

6. For each site, a separate apparatus was prepared.

To a stout bamboo, bottles were fixed, the neck of the lowest one being 1 ft. above the canal bed; and the others above it, at 2 ft. intervals.

Each bottle was numbered so that each might be fixed in the same portion for each experiment.

7. These were opened simultaneously from the surface (by a cord).

When filled, the bottles were removed to the anicut office for testing.

8. Each bottle had, before the taking of samples was begun, been marked so that the quantity in each could be reduced to exactly 20 oz.

9. When taken into the office, the quantity was first reduced to this amount after agitation, a small quantity (about 1 grain) of alum inserted and the bottle put aside to settle; after 24 hours, the clear water was syphoned off and the remaining quantity containing silt poured into a shallow sheet copper pan; the bottle was washed with a small quantity of clear water and this was added to the quantity in the pan. The residue was boiled down over a gentle fire till perfectly dry, when it was scraped out and weighed. The weighing was done with a small set of medicine scales weighing to ½ grain.

10. The measurements were recorded and the residue retained for check-weighment, etc. Five separate pans were used, which were not washed after the residue had been removed.

11. The weight of each sample total for each experiment at the respective sites and puntage were entered in a register, and that of the site near the bridge, plotted down in the monthly river charts.

12. I adopted this apparatus as it was easily supervised, cheap and required no particular skill to work. The greater part of the work after the first week or two, was done by an Engineer subordinate student Sivaswami Aiyar, who took a considerable interest in the matter, and later by an intelligent gumastah. The weighing was done to the nearest grain or ½ grain.

13. For taking the samples, a small boat was used, which was retained as nearly as possible stationary by two or more ropes from the bank. The lower end of the bamboos carrying the bottles, was placed on the bottom and prevented the apparatus from moving, till the bottles were filled.

14. The filling took a considerable time; this varied with the velocity and the depth, the time increasing from the top to the lowest bottle and the sample was thus the mean of a stream line of considerable length; this no doubt is necessary, if the sample is to be accurate, as the quantity of silt varies very much, as can be seen when the water is at all thick.

Besides the ordinary experiment, a sample was occasionally taken at 1 ft. above bed, to see whether any definite quantity of sand could be distinguished.

15. This was only done when the river was low and it was a question whether the lowest range of shutters could be opened without drawing into the canal an undue amount of sand. Such samples, when taken, were allowed to settle for two minutes or so, when the clear water was poured off; the residue, if any, could then be seen. It was not weighed, the object being to ascertain whether course sand was passing into the canal.

16. Such sand was seldom observed and the residue for the most part consisted of fine sand, most of which would probably not be deposited at the ordinary velocities met with in the main canal; the sand was partially fine and some of this took a very long time to settle. Course sand was noted on one or two occasions and when found, may have been due to eddies caused by stones in the bed.

17. The position of the Bezwada head sluice is such that the stream from the up-stream vents is thrown across to the Bezwada or left side of the canal, and observation showed that a distinct difference existed between the quantity of sand (fine and medium) brought in through the up and down stream vents in low floods.

18. I judged from this that some of the down-stream vents might be opened to their full height without any harm being done; this was tried and the samples taken were found not to show anything but fine sand.

19. I tried the experiment of keeping the undersluices nearly closed this year, as I was of opinion that the high velocity caused by their use would bring its coarse sand within range of the draw to the head sluice.

20. As regards the result of this alteration in the usual practice, the quantities of sand in the various canals appear, from a rough comparison of the soundings taken in this and with those taken in previous years, to be less than usual.

21. For instance, in the main canal, there is, as a rule, not much silt, but this year, the bed appears to be uniformly below the theoretical bed.

22. Nothing very definite can be made out from one year's experience and until the volumes of silt in fixed lengths of the canals can be calculated. This will take time and there is no one, who, at present, has time to do it.

23. No samples were taken in the river, except at the end of the season and these only near the surface.

24. As regards future experiments in the river and canals, I observe that in the experiments recorded in the Sirhind and Sone canals, very large samples are taken (10 c. ft. from each depth). This necessitates apparatus of some elaboration and the cost is much higher than would be justifiable here.

25. From the experience of this year, it appears to me that the difficulty in accurately gauging the quantities of silt is not so much in the weighing as in assuring that the samples shall be of equal volume. In the large samples above referred to, the error in cubical contents of the samples is, of course, very small.

26. For small samples to be accurate would require the capacity of the vessels used to be very carefully gauged.

27. If this were done, I am of opinion that very fair accuracy in the determination of the silt would be assured. With the apparatus used here, only small samples could be taken, and if a similar apparatus is considered suitable for future use, vessels of exactly equal capacity would be required. As regards their size, some definite fraction of a cubic foot would be the most convenient say $\frac{1}{50}$ or 34·56 cubic inches.

28. The accurate calibration of these would require apparatus not available here. It could perhaps be done with the apparatus available in the Civil Engineering College. If large samples were judged necessary, probably the best arrangements would be to use a pump with a suction pipe arranged so as to draw water from any desired depth, as in the Sirhind canal experiments.

29. If it were not required to keep the samples separate for each depth, the suction pipe could be raised and lowered with a continuous motion, while the pump was worked. A large quantity of water could then be drawn, say, 10 to 15 c.ft.; from this, several samples of smaller size could be taken and separately tested.

30. The average of four such samples would probably be sufficient; they would have to be taken while the original large sample was in a state of agitation, to avoid loss by settlement of the larger particles.

31. For taking samples in the river, a similar apparatus would be required. It would be a matter of some difficulty to arrange for a continuous set of tests in the river owing to the high velocity of the stream. The heavier sand is deposited very rapidly and so unless the samples were taken when the velocity was high enough to keep it in suspension, it would not be accurate. A fixed apparatus somewhere between the lock entrance on the Bezwada side and the head sluice might perhaps do, or an apparatus for occasional use fixed in the steamer "Havelock" could be used.

32. I think that this last would be the most convenient arrangement. During the flood season, this boat is very frequently required for towing punts and in high floods, steam is at times kept up, in case boats are in difficulties in the river and whenever this were the case, the required samples could be taken.

33. If this arrangement were approved, separate sets of apparatus for the river and canal would be required and each might consist of a small hand pump fixed to the gundate of the steamer or with about 20 ft. of flexible hose or a straight suction pipe with fixed joint. An arrangement for raising and lowering the suction pipe would be required (a stiff rod running in guides would do).

34. To receive the discharge of the pump, an ordinary cask would suffice. As regards the pumps, Messrs. Richardson & Cruddas in their catalogue advertise small and handy pumps 2 inches barrel and 1 in suction at Rs. 10 each, without suction pipe.

35. The suction pipe, if of rubber, would cost Rs. 1–2–0 per ft. and of wrought iron As. 2–4; including fitting of pump, lowering apparatus and contingencies, each apparatus would not, I think, cost more than about Rs. 50. A rotary pump in which the action is more continuous than in a reciprocating pump, would perhaps be suitable, but the smallest size advertised by Messrs. Richardson & Cruddas is priced at Rs. 60. The cost of fitting would be about the same. To measure the test samples, an accurate glass vessel would be required.

36. For separating the solid matter from the sample, boiling appears to be sufficiently satisfactory, and if the sample is small, the copper wire already in use will do very well.

37. In drying the residues, a sand bath should be used as if exposed to too great heat, it gets baked and there must be losses in weight (organic matter and water of crystallization).

38. For weighing the residues, we have been using here a cheap and probably an accurate set of medicine scales. If more accurate tests are to be taken, a more satisfactory balance than this will be required. An apparatus to weigh with accuracy from 1 grain to 2 oz., would probably suffice, but whether this could be procured in India I do not know.

39. I have mentioned above the kind of apparatus which I think would be needed.

40. As regards the system to be adopted, the chief question is the intervals at which the tests are to be taken when last year's tests were begun. I thought that a test every fourth day would do, but found that the quantities of silt carried by the water varied so rapidly that more frequent tests were advisable. Speaking generally, every rise in the river meant a corresponding rise in the silt line and *vice versâ*, so that frequent tests, when the river was rising or falling rapidly, were necessary to give correct results. In the case of a slowly falling river, the silt line fell with great regularity and tests at longer intervals were sufficient. One test a day during rising floods and during the continuance of the river at a high level would, I think, be enough, while if the river was falling regularly and slowly, one in three days might suffice.

41. The telegrams from Kurnool would give sufficient warning of floods for us to know when to prepare to take tests and the general appearance of the river water will indicate when the intervals between tests can be lengthened.

42. In addition to the measurement of total quantities of silt, subsidence tests should be undertaken. The only thing which has been done in this direction here, I have referred to

above. In paragraph 14 of the note by Mr. A. G. Reid on the silt apparatus for the Sirhind canal, this subject is referred to; three tests are there specified, viz., the results of subsidence for 1, 3 and 6 hours.

43. Now the coarse sand found here in the heads of the main canals is deposited in a very short time, say in under two minutes, and forms a distinct layer from which the silt-laden water can easily be syphoned off.

44. The fine sand is deposited more slowly. I would suggest that for our purposes the following tests should be made. A considerable bulk of water to be taken, say, ½ c. ft. This should be first allowed to settle for two minutes; then as much as possible of the water should be poured off and allowed to settle for one hour. The water to be again poured off, allowed to settle for, say, 12 hours or perhaps, till the next morning. The aggregate of these three tests would be the total of the three kinds of silt divided roughly into three classes; an equal quantity of water can be taken at the same time and the silt weighed after extraction in the ordinary way as a check.

45. The sample for sand observations should be taken at the same time as those for silt, both in river and canal.

46. I have mentioned in a previous paragraph that some rough velocity observations were taken at intervals.

47. If it is desired to carry out a continued series of observations in these canals, with the idea of establishing a relation between velocity and silt deposit, as has been done for the Punjab canal by Mr. Kennedy, it would be necessary that an officer, should be on special duty for the purpose.

48. The rough observations here were taken on the same days as the soundings and were for the most part carried out by Engineer subordinate student Sivaswami Aiyar; they were useful more for instruction purposes and were carried out by means of floating rods at five points in the cross-sections of the canal. I do not think they need be continued, though an occasional observation might be taken. Soundings were taken at each furlong in the Main, Ellore, Ryves' and Masulipatam canals, down to the second mile; there were taken weekly.

49. This year, I think, twice a month should be sufficient.

50. In addition to the weighing of the silt contained in the water, occasional specific gravity tests might be made. These would enable the actual volume of solid matter, discharged into the canals in the season, to be roughly estimated. I think that the average specific gravity of all the residues obtained in a season's experiments would be a fair approximation This could not be done here without special apparatus. I enclose a note by Mr. A. W. Campbell, Assistant Engineer, on an apparatus for testing the specific gravity of sand.

51. With this report, I forward the register of silt observations and two sheets of diagrams showing (1) the fluctuations of the river levels.

(2) Canal levels.
(3) Depth of silt in the canal.
(4) Proportion of silt in water.

52. I have now, I think, indicated fully the method on which the observations of the past year have been taken, and the alterations in system and apparatus which may be advisable in the future.

53. The apparatus is the chief difficulty, as part of it would be of a special nature, not easily procurable in India.

54. I would request that enquiry be made in Madras; as to this I have written to two or three firms regarding balances and enclose a letter regarding one which might be suitable, though it is perhaps more delicate than is necessary.

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*Letter*—from the Army and Navy Co-operative Society (Limited).
*To*—J. S. WILSON, Esq., Bezwada.
*Dated*—the 23rd March 1899.
*No.*—6/33184.

In reply to your enquiry, I beg to inform you that balances such as you require, are not stocked at this depot and none are procurable locally at a moderate price.

We enclose illustrations of a balance in case. We could import for you something after this style, but better to carry 1,000 grains, nickel-plated pans will weigh 1/20th grain; 7½" beam, stand 13 × 8, height 13½"; price about Rs. 73, weights extra, 1/10th grain to 500 grains about Rs. 12. Ordinary weights, grains and drachms would cost Rs. 2 per set. Ordinary dispensing scales will not weigh accurately less than ½ grain and if used for weighing more than ½ oz., they are likely to be strained and rendered unreliable.

**Abstract** of daily tables of silt passed by Kistna at Bezwada.

| — | 1898. | 1899. | 1900. | Average of three years. | Remarks. |
|---|---|---|---|---|---|
| Total discharge, Kistna, 22nd June to 30th November, millions of cubic feet. | 2,119,418 | 807,362 | 2,281,210 | 1,735,997 | The year 1899 was abnormal, the discharge being less than half average. |
| Total silt passed in millions of lbs. .. | 388,189 | 264,615 | 486,241 | 379,682 | |

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**Table** showing daily discharge, water and silt, Bezwada, Kistna river.

| Date. | Discharge, Kistna, in cusecs. | Discharge, Kistna, in millions cubic feet in 24 hours. | Silt in lbs. per cubic foot of water. | Total silt in millions of lbs. |
|---|---|---|---|---|
| *June 1898.* | | | | |
| 22 .. .. .. | 113,243 | 9,784 | 0·694 | 6,790 |
| 23 .. .. .. | 229,543 | 19,834 | 0·630 | 12,495 |
| 24 .. .. .. | 310,805 | 26,853 | 0·560 | 15,038 |
| 25 .. .. .. | 284,236 | 24,559 | 0·515 | 12,648 |
| 26 .. .. .. | 296,284 | 25,599 | 0·400 | 10,240 |
| 27 .. .. .. | 179,834 | 15,537 | 0·310 | 4,816 |
| 28 .. .. .. | 139,242 | 12,031 | 0·210 | 2,527 |
| 29 .. .. .. | 101,068 | 8,732 | 0·110 | 961 |
| 30 .. .. .. | 94,312 | 8,149 | 0·090 | 733 |
| Total .. | .. | 151,078 | .. | 66,248 |

This reduces to ·438 lb. of silt per cubic foot of water.

| Date. | Discharge, Kistna, in cusecs. | Discharge, Kistna, in millions cubic feet in 24 hours. | Silt in lbs. per cubic foot of water. | Total silt in millions of lbs. |
|---|---|---|---|---|
| *July 1898.* | | | | |
| 1 .. .. .. | 83,388 | 7,205 | 0·075 | 540 |
| 2 .. .. .. | 73,745 | 6,371 | 0·052 | 331 |
| 3 .. .. .. | 63,536 | 5,489 | 0·045 | 247 |
| 4 .. .. .. | 56,148 | 4,851 | 0·032 | 155 |
| 5 .. .. .. | 47,556 | 4,109 | 0·027 | 111 |
| 6 .. .. .. | 34,931 | 3,019 | 0·024 | 72 |
| 7 .. .. .. | 37,216 | 3,215 | 0·020 | 64 |
| 8 .. .. .. | 82,756 | 7,150 | 0·066 | 472 |
| 9 .. .. .. | 124,138 | 10,726 | 0·099 | 1,062 |
| 10 .. .. .. | 110,527 | 9,549 | 0·092 | 879 |
| 11 .. .. .. | 149,274 | 12,897 | 0·085 | 1,096 |
| 12 .. .. .. | 141,847 | 12,255 | 0·077 | 944 |
| 13 .. .. .. | 162,802 | 14,066 | 0·070 | 985 |
| 14 .. .. .. | 109,502 | 9,461 | 0·066 | 624 |
| 15 .. .. .. | 148,424 | 12,824 | 0·078 | 1,000 |
| 16 .. .. .. | 121,952 | 10,537 | 0·095 | 1,001 |
| 17 .. .. .. | 90,828 | 7,848 | 0·085 | 667 |
| 18 .. .. .. | 79,312 | 6,853 | 0·070 | 480 |
| 19 .. .. .. | 81,398 | 7,033 | 0·055 | 387 |
| 20 .. .. .. | 96,101 | 8,303 | 0·093 | 772 |
| 21 .. .. .. | 466,214 | 40,280 | 0·132 | 5,317 |
| 22 .. .. .. | 250,407 | 21,635 | 0·170 | 3,678 |
| 23 .. .. .. | 239,316 | 20,677 | 0·138 | 2,853 |
| 24 .. .. .. | 312,782 | 27,025 | 0·145 | 3,919 |
| 25 .. .. .. | 450,526 | 38,925 | 0·150 | 5,839 |
| 26 .. .. .. | 474,819 | 41,024 | 0·151 | 6,195 |
| 27 .. .. .. | 463,370 | 40,036 | 0·207 | 8,287 |
| 28 .. .. .. | 516,191 | 44,599 | 0·259 | 11,551 |
| 29 .. .. .. | 482,329 | 41,674 | 0·225 | 9,377 |
| 30 .. .. .. | 428,690 | 37,039 | 0·177 | 6,556 |
| 31 .. .. .. | 492,619 | 42,561 | 0·165 | 7,023 |
| Total .. | .. | 559,236 | .. | 82,484 |

This reduces to ·147 lb. of silt per cubic foot of water.

Table showing daily discharge, water and silt, Bezwada, Kistna river—*cont.*

| Date. | Discharge, Kistna, in cusecs. | Discharge, Kistna, in millions cubic feet in 24 hours. | Silt in lbs. per cubic foot of water. | Total silt in millions of lbs. |
|---|---|---|---|---|
| | | *August 1898.* | | |
| 1 .. .. .. | 156,180 | 13,494 | 0·150 | 2,024 |
| 2 .. .. .. | 446,696 | 38,593 | 0·137 | 5,287 |
| 3 .. .. .. | 416,815 | 36,012 | 0·105 | 3,781 |
| 4 .. .. .. | 397,328 | 34,329 | 0·073 | 2,506 |
| 5 .. .. .. | 368,737 | 31,859 | 0·057 | 1,816 |
| 6 .. .. .. | 351,576 | 30,376 | 0·041 | 1,245 |
| 7 .. .. .. | 357,678 | 30,904 | 0·039 | 1,205 |
| 8 .. .. .. | 313,996 | 27,130 | 0·039 | 1,058 |
| 9 .. .. .. | 276,589 | 23,897 | 0·038 | 908 |
| 10 .. .. .. | 251,879 | 21,762 | 0·034 | 740 |
| 11 .. .. .. | 241,975 | 20,907 | 0·029 | 606 |
| 12 .. .. .. | 292,255 | 25,251 | 0·029 | 732 |
| 13 .. .. .. | 231,450 | 19,997 | 0·030 | 600 |
| 14 .. .. .. | 243,500 | 21,038 | 0·027 | 568 |
| 15 .. .. .. | 264,791 | 22,878 | 0·024 | 549 |
| 16 .. .. .. | 230,724 | 19,934 | 0·021 | 419 |
| 17 .. .. .. | 216,588 | 18,713 | 0·024 | 449 |
| 18 .. .. .. | 196,230 | 16,953 | 0·026 | 441 |
| 19 .. .. .. | 169,943 | 14,683 | 0·025 | 367 |
| 20 .. .. .. | 142,241 | 12,290 | 0·025 | 307 |
| 21 .. .. .. | 116,064 | 10,027 | 0·024 | 241 |
| 22 .. .. .. | 94,046 | 8,126 | 0·022 | 179 |
| 23 .. .. .. | 103,216 | 8,917 | 0·021 | 187 |
| 24 .. .. .. | 101,983 | 8,812 | 0·021 | 185 |
| 25 .. .. .. | 89,995 | 7,776 | 0·021 | 163 |
| 26 .. .. .. | 80,917 | 6,991 | 0·016 | 112 |
| 27 .. .. .. | 17,308 | 1,496 | 0·013 | 19 |
| 28 .. .. .. | 70,625 | 6,102 | 0·013 | 79 |
| 29 .. .. .. | 71,587 | 6,184 | 0·013 | 80 |
| 30 .. .. .. | 76,194 | 6,582 | 0·013 | 86 |
| 31 .. .. .. | 96,692 | 8,353 | 0·014 | 117 |
| Total .. | .. | 560,366 | .. | 27,056 |

This reduces to ·048 lb. of silt per cubic foot of water.

| Date. | Discharge, Kistna, in cusecs. | Discharge, Kistna, in millions cubic feet in 24 hours. | Silt in lbs. per cubic foot of water. | Total silt in millions of lbs. |
|---|---|---|---|---|
| | | *September 1898.* | | |
| 1 .. .. .. | 110,51 | 9,548 | 0·016 | 153 |
| 2 .. .. .. | 112,349 | 9,707 | 0·027 | 262 |
| 3 .. .. .. | 105,781 | 9,139 | 0·039 | 356 |
| 4 .. .. .. | 94,369 | 8,154 | 0·039 | 318 |
| 5 .. .. .. | 93,174 | 8,051 | 0·039 | 314 |
| 6 .. .. .. | 104,285 | 9,010 | 0·039 | 351 |
| 7 .. .. .. | 156,606 | 13,530 | 0·080 | 1,082 |
| 8 .. .. .. | 201,009 | 17,366 | 0·121 | 2,101 |
| 9 .. .. .. | 236,920 | 20,470 | 0·212 | 4,340 |
| 10 .. .. .. | 199,608 | 17,245 | 0·323 | 5,570 |
| 11 .. .. .. | 190,415 | 16,452 | 0·305 | 5,018 |
| 12 .. .. .. | 212,105 | 18,326 | 0·286 | 5,241 |
| 13 .. .. .. | 260,912 | 22,543 | 0·267 | 6,019 |
| 14 .. .. .. | 326,533 | 28,212 | 0·338 | 9,536 |
| 15 .. .. .. | 342,950 | 29,631 | 0·410 | 12,149 |
| 16 .. .. .. | 344,920 | 29,802 | 0·385 | 11,474 |
| 17 .. .. .. | 268,857 | 22,629 | 0·360 | 8,146 |
| 18 .. .. .. | 237,409 | 20,513 | 0·305 | 6,256 |
| 19 .. .. .. | 215,635 | 18,631 | 0·250 | 4,658 |
| 20 .. .. .. | 200,656 | 17,337 | 0·194 | 3,363 |
| 21 .. .. .. | 181,980 | 15,723 | 0·150 | 2,358 |
| 22 .. .. .. | 171,200 | 14,791 | 0·105 | 1,553 |
| 23 .. .. .. | 161,412 | 13,946 | 0·087 | 1,213 |
| 24 .. .. .. | 144,431 | 12,480 | 0·068 | 849 |
| 25 .. .. .. | 126,930 | 10,967 | 0·064 | 702 |
| 26 .. .. .. | 119,633 | 10,336 | 0·060 | 620 |
| 27 .. .. .. | 113,288 | 9,788 | 0·057 | 558 |
| 28 .. .. .. | 46,577 | 4,024 | 0·052 | 209 |
| 29 .. .. .. | 94,052 | 8,127 | 0·046 | 374 |
| 30 .. .. .. | 113,432 | 9,795 | 0·078 | 764 |
| Total .. | .. | 456,273 | .. | 95,907 |

This reduces to ·21 lb. of silt per cubic foot of water.

Table showing daily discharge, water and silt, Bezwada, Kistna river—*cont.*

| Date. | Discharge, Kistna, in cusecs. | Discharge, Kistna, in millions cubic feet in 24 hours. | Silt in lbs. per cubic foot of water. | Total silt, millions of lbs. |
|---|---|---|---|---|
| | | *October 1898.* | | |
| 1 .. .. .. | 148,166 | 12,802 | 0·138 | 1,767 |
| 2 .. .. .. | 201,231 | 17,386 | 0·277 | 4,816 |
| 3 .. .. .. | 260,056 | 22,469 | 0·415 | 9,325 |
| 4 .. .. .. | 266,493 | 23,024 | 0·552 | 12,709 |
| 5 .. .. .. | 208,017 | 17,972 | 0·462 | 8,303 |
| 6 .. .. .. | 200,371 | 17,312 | 0·369 | 6,388 |
| 7 .. .. .. | 274,024 | 23,676 | 0·388 | 9,186 |
| 8 .. .. .. | 239,915 | 20,728 | 0·407 | 8,436 |
| 9 .. .. .. | 282,539 | 24,405 | 0·418 | 10,201 |
| 10 .. .. .. | 233,559 | 20,179 | 0·429 | 8,657 |
| 11 .. .. .. | 221,336 | 19,123 | 0·440 | 8,414 |
| 12 .. .. .. | 239,793 | 20,719 | 0·451 | 9,334 |
| 13 .. .. .. | 193,087 | 16,683 | 0·221 | 3,685 |
| 14 .. .. .. | 150,132 | 12,972 | 0·258 | 3,347 |
| 15 .. .. .. | 116,378 | 10,055 | 0·294 | 2,956 |
| 16 .. .. .. | 90,315 | 7,803 | 0·234 | 1,826 |
| 17 .. .. .. | 74,002 | 6,394 | 0·173 | 1,106 |
| 18 .. .. .. | 67,666 | 5,847 | 0·113 | 661 |
| 19 .. .. .. | 55,992 | 4,837 | 0·088 | 622 |
| 20 .. .. .. | 53,400 | 4,614 | 0·064 | 295 |
| 21 .. .. .. | 51,560 | 4,455 | 0·056 | 249 |
| 22 .. .. .. | 51,927 | 4,486 | 0·048 | 215 |
| 23 .. .. .. | 60,009 | 5,185 | 0·040 | 207 |
| 24 .. .. .. | 67,256 | 5,811 | 0·045 | 261 |
| 25 .. .. .. | 50,581 | 4,370 | 0·050 | 219 |
| 26 .. .. .. | 34,559 | 2,987 | 0·048 | 143 |
| 27 .. .. .. | 33,182 | 2,868 | 0·046 | 132 |
| 28 .. .. .. | 33,798 | 2,920 | 0·038 | 111 |
| 29 .. .. .. | 29,042 | 2,509 | 0·031 | 78 |
| 30 .. .. .. | 33,558 | 2,899 | 0·027 | 78 |
| 31 .. .. .. | 32,633 | 2,820 | 0·022 | 62 |
| Total .. | .. | 350,310 | .. | 113,789 |

This reduces to ·324 lb. of silt per cubic foot of water.

| Date. | Discharge, Kistna, in cusecs. | Discharge, Kistna, in millions cubic feet in 24 hours. | Silt in lbs. per cubic foot of water. | Total silt, millions of lbs. |
|---|---|---|---|---|
| | | *November 1898.* | | |
| 1 .. .. .. | 29,637 | 2,560 | 0·018 | 46 |
| 2 .. .. .. | 31,873 | 2,754 | 0·018 | 50 |
| 3 .. .. .. | 38,422 | 3,320 | 0·019 | 63 |
| 4 .. .. .. | 32,531 | 2,811 | 0·024 | 67 |
| 5 .. .. .. | 30,485 | 2,634 | 0·030 | 79 |
| 6 .. .. .. | 27,797 | 2,402 | 0·028 | 67 |
| 7 .. .. .. | 20,015 | 1,729 | 0·026 | 45 |
| 8 .. .. .. | 21,111 | 1,824 | 0·025 | 46 |
| 9 .. .. .. | 22,374 | 1,934 | 0·016 | 31 |
| 10 .. .. .. | 12,732 | 1,100 | 0·007 | 8 |
| 11 .. .. .. | 21,598 | 1,866 | 0·007 | 13 |
| 12 .. .. .. | 31,218 | 2,696 | 0·006 | 16 |
| 13 .. .. .. | 31,146 | 2,691 | 0·013 | 35 |
| 14 .. .. .. | 28,451 | 2,459 | 0·019 | 47 |
| 15 .. .. .. | 58,995 | 5,098 | 0·025 | 127 |
| 16 .. .. .. | 61,151 | 5,284 | 0·036 | 190 |
| 17 .. .. .. | 74,107 | 6,404 | 0·048 | 307 |
| 18 .. .. .. | 63,973 | 5,527 | 0·063 | 348 |
| 19 .. .. .. | 60,026 | 5,186 | 0·078 | 405 |
| 20 .. .. .. | 31,974 | 2,762 | 0·064 | 177 |
| 21 .. .. .. | 45,515 | 3,932 | 0·051 | 201 |
| 22 .. .. .. | 31,984 | 2,764 | 0·038 | 105 |
| 23 .. .. .. | 32,947 | 2,846 | 0·031 | 88 |
| 24 .. .. .. | 19,736 | 1,705 | 0·025 | 43 |
| 25 .. .. .. | 22,123 | 1,912 | 0·020 | 38 |
| 26 .. .. .. | 18,556 | 1,603 | 0·015 | 24 |
| 27 .. .. .. | 17,330 | 1,498 | 0·012 | 18 |
| 28 .. .. .. | 10,466 | 905 | 0·009 | 8 |
| 29 .. .. .. | 11,594 | 1,002 | 0·006 | 6 |
| 30 .. .. .. | 10,733 | 927 | 0·008 | 7 |
| Total .. | .. | 82,135 | .. | 2,705 |

This reduces to ·033 lb. of silt per cubic foot of water.

Table showing daily discharge, water and silt, Bewada, Kistna river—*cont.*

| Date. | Discharge, Kistna, in cusecs. | Discharge, Kistna, in millions cubic feet in 24 hours | Silt in lbs. per cubic foot of water. | Total silt in millions of lbs. |
|---|---|---|---|---|
| *June 1899.* | | | | |
| 22 .. .. .. | 86,273 | 7,452 | 0·027 | 201 |
| 23 .. .. .. | 141,981 | 12,268 | 0·794 | 9,741 |
| 24 .. .. .. | 148,941 | 12,866 | 0·585 | 7,527 |
| 25 .. .. .. | 124,204 | 10,721 | 0·428 | 4,593 |
| 26 .. .. .. | 111,154 | 9,517 | 0·321 | 3,055 |
| 27 .. .. .. | 90,424 | 7,813 | 0·219 | 1,711 |
| 28 .. .. .. | 78,632 | 6,794 | 0·170 | 1,155 |
| 29 .. .. .. | 62,433 | 5,395 | 0·134 | 723 |
| 30 .. .. .. | 57,034 | 4,928 | 0·122 | 601 |
| Total .. | .. | 77,754 | .. | 29,307 |
| This reduces to ·377 lb. of silt per cubic foot of water. | | | | |
| *July 1899.* | | | | |
| 1 .. .. .. | 76,873 | 6,642 | 0·089 | 591 |
| 2 .. .. .. | 87,291 | 7,542 | 0·069 | 520 |
| 3 .. .. .. | 108,711 | 9,392 | 0·137 | 1,287 |
| 4 .. .. .. | 100,400 | 8,675 | 0·093 | 807 |
| 5 .. .. .. | 119,253 | 10,303 | 0·094 | 968 |
| 6 .. .. .. | 135,270 | 11,688 | 0·097 | 1,134 |
| 7 .. .. .. | 124,196 | 10,731 | 0·081 | 869 |
| 8 .. .. .. | 109,630 | 9,474 | 0·066 | 625 |
| 9 .. .. .. | 98,928 | 8,550 | 0·053 | 453 |
| 10 .. .. .. | 91,849 | 7,936 | 0·048 | 381 |
| 11 .. .. .. | 86,415 | 7,466 | 0·044 | 329 |
| 12 .. .. .. | 84,416 | 7,259 | 0·037 | 269 |
| 13 .. .. .. | 73,318 | 6,334 | 0·033 | 209 |
| 14 .. .. .. | 68,016 | 5,876 | 0·026 | 153 |
| 15 .. .. .. | 85,099 | 7,353 | 0·033 | 243 |
| 16 .. .. .. | 175,931 | 15,200 | 0·090 | 1,368 |
| 17 .. .. .. | 222,048 | 19,185 | 0·150 | 2,878 |
| 18 .. .. .. | 59,671 | 5,154 | 0·360 | 1,855 |
| 19 .. .. .. | 184,823 | 15,968 | 0·230 | 3,673 |
| 20 .. .. .. | 126,154 | 10,899 | 0·180 | 1,962 |
| 21 .. .. .. | 129,906 | 11,223 | 0·170 | 1,908 |
| 22 .. .. .. | 114,433 | 9,890 | 0·094 | 930 |
| 23 .. .. .. | 93,178 | 8,049 | 0·083 | 668 |
| 24 .. .. .. | 80,337 | 6,940 | 0·058 | 403 |
| 25 .. .. .. | 72,248 | 6,243 | 0·045 | 281 |
| 26 .. .. .. | 66,399 | 5,737 | 0·036 | 207 |
| 27 .. .. .. | 62,760 | 5,324 | 0·028 | 149 |
| 28 .. .. .. | 58,448 | 5,050 | 0·024 | 121 |
| 29 .. .. .. | 56,084 | 4,846 | 0·019 | 92 |
| 30 .. .. .. | 55,570 | 4,798 | 0·026 | 125 |
| 31 .. .. .. | 50,676 | 4,378 | 0·019 | 83 |
| Total .. | .. | 264,105 | .. | 25,541 |

Total million lbs. of silt, July, 25,541. Discharge, 264,105 million cubic feet of water.
This reduces to ·097 lb. of silt per cubic foot of water.

Table showing daily discharge, water and silt, Bezwada, Kistna river—*cont.*

| Date. | Discharge, Kistna, in cusecs. | Discharge, Kistna, in millions cubic feet in 24 hours. | Silt in lbs. per cubic foot of water. | Total silt in millions of lbs. |
|---|---|---|---|---|
| *August 1899.* | | | | |
| 1 .. .. .. | 39,755 | 3,435 | 0·015 | 52 |
| 2 .. .. .. | 40,505 | 3,499 | 0·026 | 101 |
| 3 .. .. .. | 39,261 | 3,393 | 0·013 | 44 |
| 4 .. .. .. | 39,081 | 3.378 | 0·015 | 51 |
| 5 .. .. .. | 37,289 | 3,222 | 0·011 | 35 |
| 6 .. .. .. | 36,604 | 3,162 | 0·011 | 35 |
| 7 .. .. .. | 34,274 | 2,961 | 0·011 | 33 |
| 8 .. .. .. | 34,013 | 2,939 | 0·013 | 38 |
| 9 .. .. .. | 29,075 | 2,513 | 0·009 | 23 |
| 10 .. .. .. | 29,075 | 2,513 | 0·007 | 18 |
| 11 .. .. .. | 23,903 | 2,066 | 0·006 | 12 |
| 12 .. .. .. | 25,529 | 2,205 | 0·010 | 22 |
| 13 .. .. .. | 26,027 | 2,248 | 0·014 | 31 |
| 14 .. .. .. | 28,345 | 2,449 | 0·008 | 20 |
| 15 .. .. .. | 25,726 | 2,222 | 0·005 | 11 |
| 16 .. .. .. | 21,707 | 1,875 | 0·004 | 8 |
| 17 .. .. .. | 25,552 | 2,208 | 0·009 | 20 |
| 18 .. .. .. | 65,309 | 5,643 | 0·062 | 350 |
| 19 .. .. .. | 74,344 | 6,424 | 0·100 | 642 |
| 20 .. .. .. | 67,528 | 5,834 | 0·106 | 618 |
| 21 .. .. .. | 58,668 | 5,069 | 0·046 | 233 |
| 22 .. .. .. | 60,082 | 5,191 | 0·033 | 171 |
| 23 .. .. .. | 65.050 | 5,620 | 0·041 | 230 |
| 24 .. .. .. | 69,424 | 5,998 | 0·030 | 180 |
| 25 .. .. .. | 69,886 | 6,038 | 0·028 | 169 |
| 26 .. .. .. | 70,472 | 6,090 | 0·031 | 189 |
| 27 .. .. .. | 64,105 | 5,539 | 0·022 | 122 |
| 28 .. .. .. | 59,399 | 5,132 | 0·035 | 180 |
| 29 .. .. .. | 51,232 | 4,426 | 0·021 | 93 |
| 30 .. .. .. | 40,898 | 3,534 | 0·017 | 60 |
| 31 .. .. .. | 34,678 | 2,997 | 0·020 | 60 |
| Total .. | .. | 119,823 | .. | 3,851 |

This reduces to ·032 lb. of silt per cubic foot of water.

| Date. | Discharge, Kistna, in cusecs. | Discharge, Kistna, in millions cubic feet in 24 hours. | Silt in lbs. per cubic foot of water. | Total silt in millions of lbs. |
|---|---|---|---|---|
| *September 1899.* | | | | |
| 1 .. .. .. | 29,127 | 2,517 | 0·015 | 38 |
| 2 .. .. .. | 31,171 | 2,694 | 0·012 | 32 |
| 3 .. .. .. | 25,908 | 2,238 | 0·012 | 27 |
| 4 .. .. .. | 29,126 | 2,517 | 0·019 | 48 |
| 5 .. .. .. | 32,594 | 2,816 | 0·016 | 45 |
| 6 .. .. .. | 24,013 | 2,075 | 0·026 | 54 |
| 7 .. .. .. | 32,522 | 2,810 | 0·028 | 51 |
| 8 .. .. .. | 34,034 | 2,941 | 0·020 | 59 |
| 9 .. .. .. | 32,884 | 2,842 | 0·021 | 60 |
| 10 .. .. .. | 43,969 | 3,799 | 0 028 | 106 |
| 11 .. .. .. | 48,393 | 4,181 | 0·034 | 142 |
| 12 .. .. .. | 119,969 | 10,365 | 0·160 | 166 |
| 13 .. .. .. | 135,711 | 11,725 | 0·416 | 4,878 |
| 14 .. .. .. | 188,384 | 16,276 | 0·762 | 12,402 |
| 15 .. .. .. | 337,132 | 29,139 | 1·048 | 30,538 |
| 16 .. .. .. | 398,855 | 34,461 | 1·100 | 38,107 |
| 17 .. .. .. | 325,690 | 28,140 | 1·030 | 28,984 |
| 18 .. .. .. | 217,870 | 18,823 | 0·740 | 13,929 |
| 19 .. .. .. | 148,229 | 12,807 | 0·650 | 8,325 |
| 20 .. .. .. | 171,019 | 14,776 | 0·530 | 7,831 |
| 21 .. .. .. | 258,323 | 22,319 | 0·620 | 13,838 |
| 22 .. .. .. | 193,851 | 16,749 | 0·700 | 11,724 |
| 23 .. .. .. | 164,232 | 14,190 | 0·710 | 10,075 |
| 24 .. .. .. | 132,835 | 11,477 | 0·600 | 6,886 |
| 25 .. .. .. | 113,357 | 9,794 | 0 440 | 4,309 |
| 26 .. .. .. | 90,760 | 7,842 | 0·630 | 4,940 |
| 27 .. .. .. | 73,912 | 6,386 | 0·520 | 3,321 |
| 28 .. .. .. | 57,465 | 4,966 | 0·360 | 1,788 |
| 29 .. .. .. | 44,670 | 3,860 | 0·420 | 1,621 |
| 30 .. .. .. | 31,901 | 2,756 | 0·170 | 469 |
| Total .. | .. | 308,281 | .. | 204,793 |

This reduces to ·664 lb. of silt per cubic foot of water.

Table showing daily discharge, water and silt, Bezwada, Kistna river—*cont.*

| Date. | Discharge, Kistna, in cusecs. | Discharge, Kistna, in millions cubic feet in 24 hours. | Silt in lbs. per cubic foot of water. | Total silt in millions of lbs. |
|---|---|---|---|---|
| | | ***October 1899.*** | | |
| 1 .. .. .. | 31,564 | 2,727 | 0·110 | 300 |
| 2 .. .. .. | 16,932 | 1,463 | 0·107 | 157 |
| 3 .. .. .. | 20,313 | 1,755 | 0·086 | 151 |
| 4 .. .. .. | 18,308 | 1,582 | 0·038 | 60 |
| 5 .. .. .. | 19,374 | 1,675 | 0·039 | 65 |
| 6 .. .. .. | 19,863 | 1,717 | 0·041 | 70 |
| 7 .. .. .. | 20,049 | 1,732 | 0·032 | 55 |
| 8 .. .. .. | 19,139 | 1,654 | 0·031 | 51 |
| 9 .. .. .. | 17,716 | 1,530 | 0·022 | 34 |
| 10 .. .. .. | 16,212 | 1,400 | 0·018 | 25 |
| 11 .. .. .. | 9,268 | 801 | 0·016 | 13 |
| 12 .. .. .. | 10,848 | 937 | 0·013 | 12 |
| 13 .. .. .. | 10,673 | 923 | 0·011 | 10 |
| 14 .. .. .. | 10,395 | 899 | 0·010 | 9 |
| 15 .. .. .. | 10,133 | 876 | 0·008 | 7 |
| 16 .. .. .. | 10,089 | 872 | 0·008 | 7 |
| 17 .. .. .. | 9,805 | 847 | 0·009 | 8 |
| 18 .. .. .. | 9,408 | 814 | 0·009 | 7 |
| 19 .. .. .. | 6,300 | 544 | 0·006 | 3 |
| 20 .. .. .. | 6,057 | 523 | 0·006 | 3 |
| 21 .. .. .. | 6,710 | 579 | 0·007 | 4 |
| 22 .. .. .. | 6,172 | 534 | 0·007 | 4 |
| 23 .. .. .. | 6,174 | 534 | 0·007 | 4 |
| 24 .. .. .. | 7,100 | 614 | 0·010 | 6 |
| 25 .. .. .. | 7,670 | 663 | 0·013 | 9 |
| 26 .. .. .. | 7,432 | 643 | 0·017 | 11 |
| 27 .. .. .. | 6,577 | 568 | 0·006 | 3 |
| 28 .. .. .. | 8,471 | 732 | 0·006 | 4 |
| 29 .. .. .. | 8,470 | 732 | 0·006 | 4 |
| 30 .. .. .. | 7,530 | 650 | 0·006 | 4 |
| 31 .. .. .. | 6,975 | 602 | 0·006 | 4 |
| Total .. | .. | 32,122 | .. | 1,104 |

This reduces to ·034 lb. of silt per cubic foot of water.

| Date. | Discharge, Kistna, in cusecs. | Discharge, Kistna, in millions cubic feet in 24 hours. | Silt in lbs. per cubic foot of water. | Total silt in millions of lbs. |
|---|---|---|---|---|
| | | ***November 1899.*** | | |
| 1 .. .. .. | 7,167 | 619 | 0·0056 | 3 |
| 2 .. .. .. | 7,010 | 606 | 0·0040 | 2 |
| 3 .. .. .. | 6,255 | 540 | 0·0030 | 2 |
| 4 .. .. .. | 6,263 | 541 | 0·0037 | 2 |
| 5 .. .. .. | 9,335 | 807 | 0·0030 | 2 |
| 6 .. .. .. | 6,452 | 558 | 0·0038 | 2 |
| 7 .. .. .. | 6,419 | 554 | 0·0038 | 2 |
| 8 .. .. .. | 6,380 | 551 | 0·0038 | 2 |
| 9 .. .. .. | 5,926 | 511 | 0·0038 | 2 |
| Total .. | .. | 5,287 | .. | 19 |

This reduces to ·0036 lb. of silt per cubic foot of water.

| Date. | Discharge, Kistna, in cusecs. | Discharge, Kistna, in millions cubic feet in 24 hours. | Silt in lbs. per cubic foot of water. | Total silt in millions of lbs. |
|---|---|---|---|---|
| | | ***June 1900.*** | | |
| 22 .. .. .. | 14,788 | 1,278 | 0·008 | 10 |
| 23 .. .. .. | 42,756 | 3,694 | 0·029 | 107 |
| 24 .. .. .. | 35,962 | 3,107 | 0·920 | 2,858 |
| 25 .. .. .. | 117,242 | 10,130 | 1·030 | 10,444 |
| 26 .. .. .. | 120,940 | 10,446 | 0·940 | 9,819 |
| 27 .. .. .. | 114,266 | 9,873 | 1·250 | 12,341 |
| 28 .. .. .. | 93,986 | 8,121 | 0·970 | 7,877 |
| 29 .. .. .. | 85,729 | 7,406 | 0·650 | 4,814 |
| 30 .. .. .. | 68,544 | 5,922 | 0·540 | 3,198 |
| Total .. | .. | 59,977 | .. | 51,468 |

This reduces to ·86 lb. of silt per cubic foot of water.

Table showing daily discharge, water and silt, Bezwada, Kistna river—*cont.*

| Date. | Discharge, Kistna, in cusecs. | Discharge, Kistna, in millions cubic feet in 24 hours. | Silt in lbs. per cubic foot of water. | Total silt in millions of lbs. |
|---|---|---|---|---|
| *July 1900.* | | | | |
| 1 | 54,396 | 4,701 | 0·62 | 2,915 |
| 2 | 48,630 | 4,202 | 0·59 | 2,479 |
| 3 | 62,007 | 5,358 | 0·48 | 2,572 |
| 4 | 154,124 | 13,317 | 0·47 | 5,259 |
| 5 | 193,491 | 16,717 | 0·44 | 7,355 |
| 6 | 198,328 | 17,135 | 0·52 | 8,910 |
| 7 | 333,988 | 28,857 | 0·39 | 11,254 |
| 8 | 377,824 | 32,644 | 0·44 | 14,363 |
| 9 | 336,930 | 29,110 | 0·41 | 11,935 |
| 10 | 267,456 | 23,109 | 0·23 | 5,315 |
| 11 | 242,442 | 20,948 | 0·19 | 3,980 |
| 12 | 249,694 | 21,573 | 0·15 | 3,236 |
| 13 | 217,040 | 18,752 | 0·12 | 2,250 |
| 14 | 260,602 | 22,516 | 0·14 | 3,152 |
| 15 | 323,073 | 27,914 | 0·14 | 3,908 |
| 16 | 317,421 | 27,426 | 0·12 | 3,291 |
| 17 | 339,441 | 29,327 | 0·13 | 3,813 |
| 18 | 469,458 | 40,561 | 0·27 | 10,951 |
| 19 | 578,975 | 50,024 | 0·65 | 32,516 |
| 20 | 640,532 | 55,342 | 0·63 | 34,865 |
| 21 | 618,290 | 53,413 | 0·36 | 19,229 |
| 22 | 516,378 | 44,615 | 0·23 | 10,261 |
| 23 | 415,352 | 35,887 | 0·23 | 8,254 |
| 24 | 314,943 | 27,212 | 0·13 | 3,538 |
| 25 | 242,974 | 20,993 | 0·15 | 3,149 |
| 26 | 253,035 | 21,862 | 0·12 | 2,623 |
| 27 | 192,433 | 16,627 | 0·32 | 5,321 |
| 28 | 128,018 | 11,060 | 0·36 | 3,982 |
| 29 | 115,382 | 9,970 | 0·38 | 3,789 |
| 30 | 114,147 | 9,863 | 0·37 | 3,379 |
| 31 | 127,213 | 10,991 | 0·28 | 3,077 |
| Total .. | .. | 752,026 | .. | 240,921 |

This reduces to ·323 lb. of silt per cubic foot of water.

| Date. | Discharge, Kistna, in cusecs. | Discharge, Kistna, in millions cubic feet in 24 hours. | Silt in lbs. per cubic foot of water. | Total silt in millions of lbs. |
|---|---|---|---|---|
| *August 1900.* | | | | |
| 1 | 113,575 | 9,813 | 0·180 | 1,766 |
| 2 | 142,643 | 12,325 | 0·200 | 2,465 |
| 3 | 180,771 | 15,619 | 0·210 | 3,280 |
| 4 | 176,379 | 15,239 | 0·170 | 2,591 |
| 5 | 281,656 | 24,335 | 0·220 | 5,354 |
| 6 | 416,328 | 35,970 | 0·240 | 8,633 |
| 7 | 468,593 | 40,486 | 0·330 | 13,360 |
| 8 | 530,760 | 45,858 | 0·320 | 14,675 |
| 9 | 581,181 | 50,214 | 0·230 | 11,549 |
| 10 | 580,435 | 50,150 | 0·160 | 8,024 |
| 11 | 656,744 | 56,742 | 0·120 | 6,809 |
| 12 | 553,514 | 47,823 | 0·100 | 4,782 |
| 13 | 558,273 | 48,235 | 0·092 | 4,438 |
| 14 | 546,450 | 47,213 | 0·098 | 4,627 |
| 15 | 565,441 | 48,855 | 0·098 | 4,788 |
| 16 | 563,230 | 48,663 | 0·110 | 5,353 |
| 17 | 546,463 | 47,215 | 0·094 | 4,438 |
| 18 | 534,280 | 46,162 | 0·084 | 3,878 |
| 19 | 551,111 | 47,616 | 0·098 | 4,666 |
| 20 | 559,298 | 48,324 | 0·110 | 5,316 |
| 21 | 563,201 | 48,600 | 0·140 | 6,804 |
| 22 | 552,237 | 47,713 | 0·120 | 5,726 |
| 23 | 493,993 | 42,681 | 0·100 | 4,268 |
| 24 | 412,163 | 35,612 | 0·083 | 2,956 |
| 25 | 302,372 | 26,126 | 0·070 | 1,829 |
| 26 | 205,854 | 17,786 | 0·053 | 943 |
| 27 | 141,436 | 12,220 | 0·041 | 501 |
| 28 | 111,527 | 9,635 | 0·036 | 347 |
| 29 | 93,251 | 8,068 | 0·031 | 250 |
| 30 | 83,519 | 7,215 | 0·028 | 202 |
| 31 | 79,912 | 6,904 | 0·023 | 159 |
| Total .. | .. | 1,049,417 | .. | 144,777 |

This reduces to ·138 lb. of silt per cubic foot of water.

Table showing daily discharge, water and silt, Bezwada, Kistna river—*cont.*

*September 1900.*

| Date. | Discharge, Kistna, in cusecs. | Discharge, Kistna, in millions cubic feet in 24 hours. | Silt in lbs. per cubic foot of water. | Total silt in millions of lbs. |
|---|---|---|---|---|
| 1 .. .. .. | 93,603 | 8,087 | 0·049 | 396 |
| 2 .. .. .. | 104,477 | 9,028 | 0·048 | 433 |
| 3 .. .. .. | 93,594 | 8,086 | 0·025 | 202 |
| 4 .. .. .. | 87,833 | 7,589 | 0·039 | 296 |
| 5 .. .. .. | 85,683 | 7,402 | 0·033 | 244 |
| 6 .. .. .. | 75,408 | 6,516 | 0·020 | 130 |
| 7 .. .. .. | 70,154 | 6,062 | 0·015 | 91 |
| 8 .. .. .. | 62,760 | 5,423 | 0·019 | 103 |
| 9 .. .. .. | 62,027 | 5,360 | 0·015 | 80 |
| 10 .. .. .. | 72,028 | 6,324 | 0·015 | 95 |
| 11 .. .. .. | 108,482 | 9,374 | 0·025 | 234 |
| 12 .. .. .. | 136,573 | 11,800 | 0·059 | 696 |
| 13 .. .. .. | 133,988 | 11,577 | 0·140 | 1,621 |
| 14 .. .. .. | 172,224 | 14,880 | 0·110 | 1,637 |
| 15 .. .. .. | 227,044 | 19,617 | 0·210 | 4,120 |
| 16 .. .. .. | 181,620 | 15,692 | 0·420 | 6,591 |
| 17 .. .. .. | 148,786 | 12,855 | 0·330 | 4,242 |
| 18 .. .. .. | 108,086 | 9,339 | 0·290 | 2,708 |
| 19 .. .. .. | 88,490 | 7,645 | 0·270 | 2,064 |
| 20 .. .. .. | 81,753 | 7,062 | 0·180 | 1,271 |
| 21 .. .. .. | 73,593 | 6,358 | 0·140 | 890 |
| 22 .. .. .. | 68,722 | 5,937 | 0·100 | 594 |
| 23 .. .. .. | 59,824 | 5,168 | 0·077 | 398 |
| 24 .. .. .. | 55,939 | 4,832 | 0·051 | 246 |
| 25 .. .. .. | 54,350 | 4,696 | 0·051 | 239 |
| 26 .. .. .. | 55,190 | 4,768 | 0·063 | 300 |
| 27 .. .. .. | 54,286 | 4,691 | 0·053 | 249 |
| 28 .. .. .. | 57,918 | 5,003 | 0·049 | 245 |
| 29 .. .. .. | 58,583 | 5,061 | 0·049 | 248 |
| 30 .. .. .. | 59,275 | 5,122 | 0·038 | 195 |
| Total .. | .. | 241,354 | .. | 30,858 |

This reduces to ·127 lb. of silt per cubic foot of water.

*October 1900.*

| Date. | Discharge, Kistna, in cusecs. | Discharge, Kistna, in millions cubic feet in 24 hours. | Silt in lbs. per cubic foot of water. | Total silt in millions of lbs. |
|---|---|---|---|---|
| 1 .. .. .. | 206,098 | 17,806 | 0·150 | 2,671 |
| 2 .. .. .. | 226,683 | 19,586 | 0·210 | 4,113 |
| 3 .. .. .. | 176,502 | 15,249 | 0·140 | 2,135 |
| 4 .. .. .. | 148,520 | 12,832 | 0·100 | 1,283 |
| 5 .. .. .. | 137,856 | 11,911 | 0·083 | 989 |
| 6 .. .. .. | 115,499 | 9,979 | 0·095 | 948 |
| 7 .. .. .. | 83,254 | 7,193 | 0·110 | 711 |
| 8 .. .. .. | 63,956 | 5,526 | 0·140 | 774 |
| 9 .. .. .. | 55,646 | 4,808 | 0·140 | 673 |
| 10 .. .. .. | 54,691 | 4,725 | 0·180 | 851 |
| 11 .. .. .. | 49,660 | 4,288 | 0·130 | 557 |
| 12 .. .. .. | 46,740 | 4,037 | 0·110 | 444 |
| 13 .. .. .. | 35,227 | 3,043 | 0·110 | 335 |
| 14 .. .. .. | 33,505 | 2,894 | 0·100 | 289 |
| 15 .. .. .. | 25,305 | 2,186 | 0·059 | 129 |
| 16 .. .. .. | 25,850 | 2,233 | 0·041 | 92 |
| 17 .. .. .. | 24,151 | 2,087 | 0·021 | 44 |
| 18 .. .. .. | 23,161 | 2,001 | 0·022 | 44 |
| 19 .. .. .. | 41,649 | 3,598 | 0·030 | 108 |
| 20 .. .. .. | 38,191 | 3,299 | 0·029 | 96 |
| 21 .. .. .. | 36,095 | 3,119 | 0·025 | 78 |
| 22 .. .. .. | 29,641 | 2,560 | 0·021 | 54 |
| 23 .. .. .. | 20,060 | 1,734 | 0·055 | 95 |
| 24 .. .. .. | 24,784 | 2,141 | 0·080 | 171 |
| 25 .. .. .. | 24,012 | 2,075 | 0·043 | 89 |
| 26 .. .. .. | 21,784 | 1,881 | 0·025 | 47 |
| 27 .. .. .. | 20,030 | 1,731 | 0·018 | 31 |
| 28 .. .. .. | 18,308 | 1,582 | 0·026 | 41 |
| 29 .. .. .. | 21,232 | 1,834 | 0·026 | 48 |
| 30 .. .. .. | 19,574 | 1,691 | 0·025 | 42 |
| 31 .. .. .. | 15,034 | 1,299 | 0·021 | 27 |
| Total .. | .. | 160,928 | .. | 18,009 |

This reduces to ·112 lb. of silt per cubic foot of water.

**Table showing daily discharge, water and silt, Bezwada, Kistna river—*cont.***

| Date. | Discharge, Kistna, in cusecs. | Discharge, Kistna, in millions cubic feet in 24 hours. | Silt in lbs. per cubic foot of water. | Total silt, millions of lbs. |
|---|---|---|---|---|
| *November 1900.* | | | | |
| 1 | 15,005 | 1,296 | 0·0190 | 25 |
| 2 | 11,149 | 963 | 0·0150 | 14 |
| 3 | 11,416 | 986 | 0·0590 | 58 |
| 4 | 12,539 | 1,084 | 0·0120 | 13 |
| 5 | 12,953 | 1,119 | 0·0110 | 12 |
| 6 | 12,834 | 1,109 | 0·0100 | 11 |
| 7 | 13,363 | 1,155 | 0·0110 | 13 |
| 8 | 13,283 | 1,148 | 0·0120 | 14 |
| 9 | 12,810 | 1,107 | 0·0110 | 12 |
| 10 | 12,315 | 1,064 | 0·0075 | 8 |
| 11 | 11,126 | 961 | 0·0088 | 8 |
| 12 | 7,442 | 644 | 0·0050 | 3 |
| 13 | 8,458 | 731 | 0·0050 | 4 |
| 14 | 8,462 | 732 | 0·0038 | 3 |
| 15 | 8,444 | 730 | 0·0038 | 3 |
| 16 | 8,329 | 720 | 0·0038 | 3 |
| 17 | 7,302 | 631 | 0·0024 | 2 |
| 18 | 7,897 | 682 | 0·0012 | 1 |
| 19 | 7,460 | 646 | 0·0012 | 1 |
| Total | .. | 17,508 | .. | 208 |

This reduces to ·012 lb. of silt per cubic foot of water.

| Date. | Discharge, Kistna, in cusecs. | Discharge, Kistna, in millions cubic feet in 24 hours. | Silt in lbs. per cubic foot of water. | Total silt, millions of lbs. |
|---|---|---|---|---|
| *June 1901.* | | | | |
| 1 | 22,068 | 1,907 | 0·041 | 78 |
| 2 | 19,658 | 1,698 | 0·038 | 65 |
| 3 | 8,938 | 772 | 0·036 | 28 |
| 4 | 9,190 | 794 | 0·037 | 29 |
| 5 | 8,294 | 716 | 0·027 | 19 |
| 6 | 4,864 | 421 | 0·021 | 9 |
| 7 | 38,579 | 3,333 | 0·056 | 187 |
| 8 | 47,529 | 4,106 | 0·110 | 452 |
| 9 | 20,872 | 1,803 | 0·104 | 188 |
| 10 | 24,740 | 2,138 | 0·167 | 357 |
| 11 | 21,860 | 1,888 | 0·654 | 1,235 |
| 12 | 9,791 | 846 | 0·182 | 154 |
| 13 | 12,808 | 1,107 | 0·069 | 76 |
| 14 | 15,903 | 1,374 | 0·045 | 62 |
| 15 | 55,537 | 4,798 | 0·034 | 163 |
| 16 | 11,736 | 1,013 | 0·026 | 26 |
| 17 | 9,785 | 846 | 0·032 | 27 |
| 18 | 11,796 | 1,019 | 0·032 | 33 |
| 19 | 11,162 | 965 | 0·031 | 30 |
| 20 | 115,881 | 10,013 | 0·730 | 7,309 |
| 21 | 146,015 | 12,615 | 1·360 | 17,156 |
| 22 | 113,258 | 9,785 | 1·470 | 14,384 |
| 23 | 96,000 | 8,294 | 1·080 | 8,958 |
| 24 | 88,924 | 7,683 | 0·750 | 5,762 |
| 25 | 85,643 | 7,400 | 0·580 | 4,292 |
| 26 | 72,927 | 6,300 | 0·570 | 3,591 |
| 27 | 63,940 | 5,524 | 0·510 | 2,817 |
| 28 | 58,557 | 5,059 | 0·380 | 1,922 |
| 29 | 54,775 | 4,733 | 0·280 | 1,325 |
| 30 | 48,425 | 4,184 | 0·200 | 837 |
| Total | .. | 113,134 | .. | 71,571 |

This reduces to ·633 lb. of silt per cubic foot of water.

Table showing daily discharge, water and silt, Bezwada, Kistna river—*cont.*

| Date. | Discharge, Kistna, in cusecs. | Discharge, Kistna, in millions cubic feet in 24 hours. | Silt in lbs. per cubic foot of water. | Total silt in millions of lbs. |
|---|---|---|---|---|
| *July 1901.* | | | | |
| 1 .. .. .. | 39,642 | 3,426 | 0·130 | 445 |
| 2 .. .. .. | 47,574 | 4,111 | 0·190 | 781 |
| 3 .. .. .. | 46,632 | 4,029 | 0·120 | 483 |
| 4 .. .. .. | 45,764 | 3,954 | 0·120 | 474 |
| 5 .. .. .. | 41,991 | 3,628 | 0·130 | 472 |
| 6 .. .. .. | 64,066 | 5,536 | 0·120 | 664 |
| 7 .. .. .. | 69,458 | 6,002 | 0·230 | 1,380 |
| 8 .. .. .. | 64,510 | 5,574 | 0·300 | 1,672 |
| 9 .. .. .. | 87,111 | 7,527 | 0·560 | 4,215 |
| 10 .. .. .. | 136,514 | 11,794 | 0·400 | 4,718 |
| 11 .. .. .. | 147,426 | 12,738 | 0·670 | 8,534 |
| 12 .. .. .. | 163,887 | 14,160 | 0·330 | 4,673 |
| 13 .. .. .. | 313,362 | 27,075 | 0·370 | 10,018 |
| 14 .. .. .. | 485,846 | 41,977 | 0·720 | 30,223 |
| 15 .. .. .. | 470,467 | 40,649 | 0·620 | 25,202 |
| 16 .. .. .. | 438,442 | 37,882 | 0·390 | 14,774 |
| 17 .. .. .. | 379,270 | 32,760 | 0·240 | 7,862 |
| 18 .. .. .. | 348,315 | 30,094 | 0·190 | 5,718 |
| 19 .. .. .. | 336,575 | 29,080 | 0·160 | 4,653 |
| 20 .. .. .. | 320,398 | 27,683 | 0·170 | 4,706 |
| 21 .. .. .. | 270,612 | 23,381 | 0·240 | 5,611 |
| 22 .. .. .. | 245,677 | 21,227 | 0·190 | 4,033 |
| 23 .. .. .. | 241,776 | 20,889 | 0·088 | 1,838 |
| 24 .. .. .. | 240,283 | 20,761 | 0·077 | 1,599 |
| 25 .. .. .. | 244,993 | 21,167 | 0·072 | 1,524 |
| 26 .. .. .. | 254,091 | 21,954 | 0·066 | 1,449 |
| 27 .. .. .. | 210,982 | 18,129 | 0·092 | 1,668 |
| 28 .. .. .. | 208,136 | 17,983 | 0·085 | 1,529 |
| 29 .. .. .. | 195,057 | 16,853 | 0·088 | 1,483 |
| 30 .. .. .. | 198,836 | 17,179 | 0·083 | 1,426 |
| 31 .. .. .. | 312,957 | 27,039 | 0·082 | 2,217 |
| Total .. | .. | 576,241 | .. | 156,044 |

This reduces to ·271 lb. of silt per cubic foot of water.

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## III

*Letter*—from Lieut-Col. W. M. ELLIS, R.E., Superintending Engineer on Special duty.
*To*—the Chief Engineer for Irrigation.
*Dated*—the 6th April 1909.
*No.*—130 I.

In continuation of this office No. 113 I., dated 27th March 1909, I forward a note on proposed arrangements for taking silt observations in Kistna river at Pulichintala during next flood season (June to November).

The note has been drawn up after taking the advice of the Chemical Examiner.

It will be noted that my proposed arrangements have been much modified by this advice.

The note has been seen and approved by the Chemical Examiner (Major Miller, I.M.S.) and a copy of that officer's letter regarding it, is enclosed (No. 604, dated 5th April 1909).

2. I am working out the details of the apparatus necessary for taking samples of silt, and will arrange details regarding despatch of samples, labelling of bottles, etc., with the Chemical Examiner and the Executive Engineer.

It may be noted that further establishment is required in connection with this work, viz.—

One Upper Subordinate, Public Works Department, a reliable man of some experience, but not over forty years of age, is required from 1st June to 30th November.

One skilled subordinate for special work under the Chemical Examiner, from 1st July to 31st December.

I would ask that one extra Upper Subordinate be sanctioned for, and posted to, Kistna Reservoir project to actually report to the Executive Engineer at Guntúr by 1st June.

I further request that the Chemical Examiner be authorised to arrange for the appointment of a suitable assistant at a salary of Rs. 100 from 1st July and to make the necessary preliminary arrangements for the work.

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Enclosures.

*Letter*—from Major Miller, I.M.S., Chemical Examiner, Madras.
*To*—the Special Superintending Engineer.
*Dated*—the 5th April 1909.
*No.*—604.

In reply to your letter No. 272 M., dated 3rd April 1909, I have the honour to state that the enclosed "Note on proposed arrangements for silt observation, Kistna," correctly states my views on the matter, and that I have no additional remarks to make, except that I see no objection to your proposal to use two one quart bottles in place of the larger Winchester quart bottles for each sample.

One copy of the note is herewith returned.

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*Note on proposed arrangements for silt observation, Kistna.*

I consulted Major Miller, I.M.S., Chemical Examiner to Government, to-day (2nd April 1909) on the matter of the silt observations, which it is proposed to take in Kistna during the next flood season, and this note embodies the results of the interview and states the proposals put forward.

2. My original proposal was to take samples of silt from Kistna river by lowering into the river vertically, a 4″ pipe with a foot-valve, which was to be kept open during lowering, but closed, immediately the pipe reached a certain distance (generally 1 foot) above the river bed.

Such a means of collecting silt ensures that the sample contains a fair average total quantity of silt of the river taken from all depths.

3. Such a pipe has capacity of 1 cubic foot for 11½ feet (about). Thus the samples taken from Kistna with a normal depth of, say, 20 feet, would be about 2 cubic feet and this would run up in ordinary floods to 4 cubic feet and in extraordinary ones, to 5 cubic feet. The maximum weight of suspended silt may amount to 1 lb. per cubic foot and thus the total of silt for one day might amount on an occasion to, say, 4 lbs. and it would be quite common to have to deal with 1½ to 2 lbs. of silt (that is, silt weighing this, after drying).

4. It was proposed to run the silty water from the collecting pipe by means of suitably placed draw-off locks into specially made containers of 1 cubic foot capacity each, to settle the silt in these containers with a little alum and syphon off clear water.

The residue to be run off into iron pans placed over specially constructed flues and evaporated to dryness and weighed.

5. It is at this last stage that the Chemical Examiner has intervened, pointing out—

(*a*) that evaporation has the effect of depositing dissolved salts (this, however, would be not a large item) ;

(*b*) that drying of considerable quantities of silt is a tedious and, with the apparatus proposed, a very uncertain, operation. It is stated that no one can judge the dryness by examination and it is only by weighing accurately further drying and re-weighing, that the absence of moisture can be assured. Further, that the errors likely to occur from this source are very material and the larger the sample of silt, the greater the percentage of probable error.

(*c*) He brings to notice that if the weight of the pans is great in comparison to the weight of silt, accuracy in weighing would be impaired, if the drying pans were weighed with the silt, while removal of the silt from the pans for weighing introduces a possible loss and error, which might be very material.

(*d*) If the pans are heated to an unduly high temperature, the silt will be effected by volatilization of vegetable substances, etc., while if only low temperatures are applied, the time of drying will be long.

On the whole, he expresses a decided opinion that the results we are likely to get by local drying and weighing, will be much more inaccurate as well as more expensive to arrive at, than the results obtainable by furnishing him with comparatively small samples of water containing a true average amount of silt, which can be dealt with by settling, filtering, drying and weighing with properly-installed apparatus, with a skilled and trained man to take observations.

I then suggested that it might suit, if the settling the silt and syphoning-off the clear water were done at the river side, so that the bulk of samples for test to be transported might be reduced. This, however, is objected to, as it necessitates weighing and drying the whole sample sent, whereas the proposed method of treatment contemplates dealing with different quantities of the samples sent in accordance with the quantities of silt in suspension.

6. After discussion, it is proposed that the Chemical Examiner shall weigh and measure the samples and that these should be sent to him and shall be a fair sample of the river water with its silt and that each sample sent shall be two imperial quarts in glass stoppered bottles—the bottles suggested being those known as "Winchester quarts".

On reconsideration, I think it will be better to send each sample in two bottles of one quart each, so that in case of loss or breakage in transit of one bottle, at least half the sample will be available for test, and the remarks of the Chemical Examiner on this modification will be requested.

Each week one box containing half the samples of silt of that week will be despatched by rail to Madras and another box containing the second halves of the same samples. Specially made boxes with compartment will be made for the bottles and the empties will be returned weekly.

7. The work to be done at site will thus be limited to taking the silty water and bottling a sample of the same containing a fair average of the silt and despatch after proper labelling of the bottles and record of the number, date, etc., and other particulars of the sample in a register.

8. In view of this alteration with the propriety of which I fully concur, the apparatus at site will be modified and need not be nearly so elaborate as would be necessary, if all the work must be done at site. The proposed drying house with its flues and chimney, the 15 to 20 silt vessels and drying pans, the weighing scales, etc., can be dispensed with and what we require now is—

(*a*) Collecting pipe of aggregate length, 60 feet, jointed in lengths 4 to 12 feet. In view of the altered arrangements, it is considered 2″ pipes will be suitable.

(*b*) A silt tank into which the silty water will be piped from the collecting pipe.

This should be a galvanized iron tank about 18 gallons capacity mounted on a stand, capable of being shaken so as to agitate the liquid and assist in mixing up the silt well, while a sample is being drawn off.

If some kind of mechanical stirrer can be fitted, this will be done, but failing this, the tank will be shaken and hand-stirred, while the drawing-off of the sample is taking place.

(*c*) Glass stoppered bottles in suitable capacity and numbers with boxes, labels, etc.

(*d*) A steel punt already at Pulichintala will be used to take samples from, and the punt will be worked from a steel wire rope stretched across, the river. Light shear legs on the stern of the punt will be fitted, from which the collecting pipes can be suspended for collecting the sample of silt.

9. The Chemical Examiner will require to employ a special man to deal with the daily samples of silt sent him from 1st July for six months on Rs. 100 per month. A selected upper subordinate will be required to be at site at Pulichintala from 1st June to 30th November to personally take and bottle the silt samples and at the same time to take and record surface velocities of water-gauge reading, etc. This subordinate will be available for supervision of works in the immediate vicinity, but his chief duty will be taking daily silt samples. Lascars for working the punt will also be required.

10. The cost of the operation may be roughly estimated as follows :—

*Works.*

| | RS. | RS. |
|---|---|---|
| Fitting for punt, silt tube, silt tank ... ... ... ... | 400 | |
| Steel wire rope, including anchorage and erection ... ... | 600 | |
| Bottles and boxes, etc. ... ... ... ... ... ... | 150 | |
| Shed for upper subordinate ... ... ... ... ... | 250 | |
| Minor fittings ... ... .. ... ... ... ... | 50 | |
| Total ... | | 1,450 |
| Upper subordinate for six months, Rs. 100 ... ... ... | 600 | |
| Chemical Examiner extra staff, six months, Rs. 100 ... ... | 600 | |
| One tyndal, six months, Rs. 10 ... ... ... ... ... | 60 | |
| Four lascars, six months, Rs. 8 each ... ... ... ... | 192 | |
| Total ... | | 1,452 |
| Railway freight, cartage, etc. ... ... ... ... ... | 300 | |
| Unforeseen charges ... ... ... ... ... ... | 298 | |
| Total ... | | 598 |
| Grand Total ... | | 3,500 |

## IV

*Letter*—from Lieut.-Col. W. M. ELLIS, R.E., Superintending Engineer on Special duty.
*To*—the Chief Engineer for Irrigation.
*Dated*—Madras, the 6th April 1909.
*No.*—131 I.

In continuation of this office No. 130 I., dated 6th April 1909, on the subject of silt observations in Kistna, I have the honour to inform you that in addition to the taking of samples at Pulichintala, I suggest that it is most desirable to take during this year samples of silt in the Eastern Main canal, Bezwada, and that these samples should be taken with bottles and dealt with in the same manner as the previous samples taken in 1899 and 1900, with the exception only that the mark on the bottles indicating the capacity of the sample to be taken, be near the base of the neck of the bottle and not on the main body—this small alteration permits more accurate measurement.

Occasionally (say three or four times monthly) duplicate samples of silt should be taken at Bezwada and one sample sent to the Chemical Examiner for test.

By comparison between the results obtained, in the laboratory with the rougher tests, some idea of the centage of error will be obtained.

The chief object of the proposed observations at Bezwada is to enable a comparison to be made of the results there obtained, with those given from the samples of silty water taken from the river at Pulichintala.

If it is found that a relation between these can be established within reasonable limits of deviation, it will enable us to apply to the river water the observation taken in 1898, 1899, 1900 and 1901 in the main canal at Bezwada If no relation between the river silt observed at Pulichintala and the canal silt observed at Bezwada can be established, it will show us that we cannot compute the river silt discharges from the old observations. I think this is a most important point.

2. As regards, the establishment for carrying out this work, I think one upper subordinate could gauge the main canal daily and also take all silt samples and observations.

I believe a special upper subordinate for velocity observations is being employed for Kistna Eastern canals this year, but he could probably not be spared to give all his time to the main canal.

I mention, however, for information that the man who was carrying out observations in 1899 and 1900, viz., Narasimha Rao, is now a sub-overseer at Ellore and might be placed on special duty for this work. His pay would be a fair charge against the Reservoir project.

The work would have to be carried out in the II Circle under local officers, and it is believed this would not constitute any difficulty.

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## V

**Memorandum No. 36-O., dated 5th May 1909.**

With reference to his letters No. 113 I., dated 27th March 1909, and No. 130 I., dated 6th April 1909, the Superintending Engineer on Special duty is informed that his proposals for taking silt observations in the Kistna river at Pulichintala during the next flood season (June to November) are approved. Steps are being taken to obtain the sanction of Government to the establishment applied for.

2. The proposal to take silt observations in the Kistna East main canal, Bezwada, made by the Special Superintending Engineer in his letter No. 131 I., dated 6th April 1909, is also approved.

(By Order.)

T. W. S. SMYTH,
*Asst. Chief Engineer for Irrigation.*

To the Superintending Engineer on Special duty.
Copy to the Superintending Engineer, II Circle.

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## VI

### Memorandum Ref. on Cur. No. 28-Ooty, dated 21st May 1909.

The Chief Engineer for Irrigation has the honour to forward copies of the following documents :—

Demi-official from the Chief Engineer for Irrigation to the Inspector-General of Irrigation, dated 7th/10th April 1909.

Demi-official from the Inspector-General of Irrigation to the Chief Engineer for Irrigation in reply to the above and forwarding an advance copy of a note by the Inspector-General of Irrigation.

It is requested that the Special Superintending Engineer will take steps (after consultation with the Executive Engineer as proposed by him) to carry out the Inspector-General's proposal to defer investigation of the upland canal. In doing this, it appears advisable to continue investigation for the present only to a sufficient extent to enable the line of main canal to be fairly approximately located and enable a fairly close preliminary estimate of the probable cost to be made.

2. It must be admitted now with regret that the prospects of success of any single reservoir on the main river are very remote on account of the silt difficulty, and it therefore seems probable that one of the following alternatives will have to be considered :—

(*a*) A storage reservoir on one of the tributaries, probably the Tungabhadra, with a subsidiary dam at Pulichintala for the upland canal.

(*b*) A storage reservoir as at (*a*) for the delta above.

3. For the purposes of (*a*), it appears to the Chief Engineer for Irrigation that the time has now come to work out preliminary proposals and forecasts of cost for the subsidiary dam and upland canal, to ascertain whether the revenue expected from this upland canal will justify this expenditure, together with such proportion of the cost of the storage reservoir as is due to the extra capacity required for the upland canal. If the forecasts show that the upland canal under these circumstances will not pay, it will be necessary to find out if the Revenue Department will agree to raising the rate for this canal to a sufficient extent to make it pay, and, if not, it will be necessary to abandon this part of the scheme (assuming, of course, that the silt difficulty is finally found to make a reservoir on main river impracticable).

In considering this aspect of the question, it may be found that with a subsidiary dam, it may be better to lower the level of the offtake of upland canal, but it is probable that this work will be fixed more by the facilities for passing the river flood discharges than by anything else.

It is therefore requested that the Superintending Engineer will be so good as to take the necessary action as above, as soon as practicable.

4. As regards (*b*), it is improbable that from an engineering point of view, a better site for a storage reservoir on the Tungabhadra than that selected for the project of that name near Hospet, will be found.

5. As, however, there are likely to be difficulties with Hyderabad with regard to the acquisition of the waterspread, it is absolutely necessary to ascertain that no other suitable sites exist upon the tributary. The Superintending Engineer is therefore requested to take steps to ascertain this as soon as possible.

C. A. SMITH,
*Chief Engineer for Irrigation.*

To the Superintending Engineer on Special duty.

## VII

*Letter*—from H. M. WILLMOTT, Esq., Under Secretary to the Government of India, Public Works Department (Civil Works—Irrigation).
*To*—the Joint Secretary to the Government of Madras, Public Works Department, Irrigation Branch.
*Dated*—Simla, the 18th May 1909.
*No.*—544 I.

In continuation of this office letter No. 447 I., dated the 28th April 1909, I am directed to forward, for the information and consideration of the Governor in Council, a copy of a note, dated the 3rd May 1909, by the Inspector-General of Irrigation on the proposed Kistna Reservoir Project.

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ENCLOSURE.

*Note on the proposed Kistna Reservoir Project by Mr. J. BENTON, C.I.E., Inspector-General of Irrigation, dated 3rd May* 1909.

*Previous note.*—This note is supplementary to my previous one on the same subject, dated 3rd April 1909, in which I dealt with the question of silting of the reservoir in paragraphs 15 to 26. It appears to me that liability to silting up of the reservoir is a very serious matter, and I asked to be furnished with the results of observations which, I was informed, had been carried out about ten years previously by Mr. J. S. Wilson, Executive Engineer.

2. *Observations of* 1898—1900.—Mr. C. A. Smith, Chief Engineer for Irrigation Works, has kindly supplied me with the following :—

(i) Tabular statements showing for the six months June to November in the years 1898 to 1900 the daily discharge of river, and the amount of silt carried, as deduced by Colonel W. M. Ellis, R.E., from experiments which were carried on fairly continuously for these periods.

(ii) A copy of letter No. 873-S.E., dated 31st March 1899, of Mr. J. S. Wilson, Executive Engineer, Kistna Eastern Division, Bezwada, to the Superintending Engineer, II Circle, which very clearly explains how the observations were made.

(iii) A copy of a note by Colonel Ellis, R.E., dated 7th April 1909, on the probable life of the reservoir and means of prolonging the same.

3. *Daily discharges and silt in suspension.*—The execution of the experimental observations was under the direction of Mr. J. S. Wilson, Executive Engineer, while it is stated that the greater part of the work, after the first week or two, was done by an Engineer Subordinate student Sivaswami Aiyar who, it is stated, took a considerable interest in the matter, and later by an intelligent gumasta. The observations were made in the Kistna Eastern Main Canal, the procedure being as described in Appendix A to this note. Appendix B is an abstract of Colonel Ellis' daily discharge statement, with the silt in pounds reduced to cubic feet by dividing by 112 ; this appendix shows as follows :—

(i) That the proportions by volume of the silt held in suspension to the water varied greatly in different months, and also in the corresponding months of each of the three years covered by the observations.

(ii) That the proportions of silt are very large, the aggregate for each of the three years being as follows in millions of cubic feet—

| Year | Silt. | Silt / Water. |
|---|---|---|
| 1898 ... ... ... ... ... ... ... ... | 3,464 | 1/611 |
| 1899 ... ... ... ... ... ... ... ... | 2,360 | 1/342 |
| 1900 ... ... ... ... ... ... ... .. | * 4,340 | † 1/526 |

* Average 3,388 millions cubic feet. † By volume.

Omitting 1899, which was a year of unusually low supply in the river, the average for 1898 and 1900 was 3,902 millions cubic feet.

4. Since the proposed capacity of the reservoir is 151 and 183 thousand millions cubic feet up to full tank level, and to 10 feet over that level respectively which the dam would suffice to store, it will be seen that the reservoir would silt up as follows :—

(i) To full tank level in 38 years.
(ii) To 10 feet over full tank level in 47 years.

Both these periods are ones of small duration in the life of a great irrigation scheme, and long before the reservoir had completely silted up, it would be very inefficient ; any such short lives for the reservoir would call for rejection of the scheme.

5. *Character of the observations of* 1898–1900.—The observations were apparently carefully made, but for determination of the very important question now at issue, the following views may be held—

(i) Without casting any aspersion on the subordinate engineer student who made the observations, and the intelligent gumasta who succeeded him, these are not men of the class which would be deputed to determine the life of a great irrigation work; it was never contemplated that the results would be utilized for settling any question of momentous importance, such as that now at issue.

(ii) The observations were made in the Eastern Main Kistna Canal, where the proportion of silt may not be the same as the average in the river, while it is the latter which will affect a great reservoir, trapping nearly the whole of the silt held in suspension.

6. *Analysis of observations.*—I have prepared Appendix C to this note in the following manner. I divided the tabular statements referred to in paragraph 2 (i) *supra* into eight portions, in which the daily discharges were from 0 to 50,000—50,000 to 100,000—600,000 to 700,000 cusecs, and I averaged the silt in pounds per cusec foot which was held in suspension for each period; the results month by month are given in the appendix under reference, and the number of days is written under the number in each case. For flood water coming mainly from the same drainage tract, it might be expected that the early floods in June when the monsoon bursts, would carry an abnormal amount of silt and that the higher the flood, the greater would be the amount of silt swept along. It might at first sight be expected that floods of similar magnitude in corresponding months of different years would carry about the same proportion of silt; inspection of Appendix C goes to show that this is not the case, and we are left in doubts as to which of the following explanations afford reasons for the great discrepancies:—

(i) The Kistna drains numerous widespread tracts, differently circumstanced as to errodibility and quantity of soil, in which the rainfall no doubt varied greatly, while any detritus swept into the main channel would be mostly carried forward owing to the great declivity.

(ii) Operations in regulating the canal head would probably greatly affect the silt swept into the channel, while the set of the river near the off-take would also affect it.

(iii) The observations may have been faulty.

Before hazarding any opinion as to which of these explanations applies, I will briefly glance at what we know of the proportions of silt carried by some other rivers.

7. *Silt carried by some other rivers.*—Mr. R. B. Buckley, C.S.I., furnishes a good many particulars on this subject in his work on "Facts, Figures and Formula for Irrigation Engineers"; selecting the more important data, we have as follows:—

(*a*) *Sirhind canal.*—It is in my personal knowledge that the experiments were carried out on a very large scale, and with scrupulous attention to accuracy on the part of the Engineer officers in charge, since this canal threatened at one time to be unworkable. The river bed is sandy, and the velocity varies from 2·5 to 11 feet per second according to the volume discharged. The quantity of damp silt to one cubic foot of water were as follows from June to September—

| | | |
|---|---|---|
| 1895 ... ... ... ... ... ... | 0·00165 cubic foot | or 1/606 |
| 1896 ... ... ... ... ... ... | 0·00234 ,, | or 1/427 |
| 1897 ... ... ... ... ... ... | 0·00546 ,, | or 1/183 |

The particulars given by Mr. Buckley regarding the silt in the Sutlej, from which the Sirhind canal draws its supply, go to show that the proportion of silt in the former was considerably more than in the canal, as is natural.

(*b*) *Sone canal.*—The average volume of wet silt per cubic foot of water in 1898 is given as follows:—

| | | |
|---|---|---|
| June ... ... ... ... ... ... | 0·001875 cubic foot | or 1/533 |
| July ... ... ... ... ... ... | 0·003250 ,, | or 1/308 |
| August ... ... ... ... ... ... | 0·002750 ,, | or 1/364 |
| September ... ... ... ... ... | 0·000625 ,, | or 1/1600 |
| October ... ... ... ... ... ... | 0·000062 ,, | or 1/16129 |

These results go to show that there is no good reason to doubt the proportions of silt to water as exhibited in Appendix C, simply because they are much larger than expected. The Kistna experimental results go to show that the water in that river is just about as turbid as in the Sutlej, which feeds the Sirhind canal, or as in the Sone river in Bengal. It is not known what the declivity and velocities are in the Kistna, but in high conditions of the river, the depth will be from 2 to 3 times as much as in the two other rivers just mentioned.

8. *Conclusion as to past experimental results.*—At first sight these do not appear very consistent with themselves, while they go to show that the Kistna flood water carries very large quantities of silt; it may be found that the results of the past experiments are substantially correct—*vide* paragraph 7 *supra*. For present purposes, it appears to me prudent to assume that the Kistna flood waters carry as much silt as indicated by the experiments of 1898—1900, and to devise a project which will be suitable under these circumstances.

9. *Further experimental determinations.*—I understand that the Chief Engineer proposes to determine experimentally the proportion of silt carried by the Kistna river during next Kharif (June to November) and this appears advisable; I would strongly advise that the same course should be followed with regard to the Cauvery river, on which a similar storage work is proposed.

10. *Safe manner of operating.*—As already suggested in my note, dated 3rd April 1909, paragraphs 15 and 21, the safe procedure in operating a storage work on the Kistna river so as to ensure it having a reasonably long period of utility, will be to arrange, if possible, for a reservoir which can be scoured out for the greater part of the flood season and that it may only be closed for a reasonably short period at the end of it, when the water is less turbid. The turbid character of the flood water as now disclosed, the practice elsewhere and logical reasoning, all appear to point clearly to this course of procedure as being necessary.

11. *Objects of Kistna project.*—In order to have a clear conception of the objects in view and of the relative importance of these, I give the various areas below as furnished by the Superintending Engineer :—

| | |
|---|---|
| | ACS. |
| (i) Increase of irrigation in the delta comprising— | |
| (*a*) First crop ... ... ... ... ... ... ... | 200,000 |
| (*b*) Second crop ... ... ... ... ... ... ... | 205,000 |
| (ii) Upland canal— | |
| (*a*) First crop ... ... ... ... ... ... ... | 500,000 |
| (*b*) Second crop ... ... ... ... ... ... ... | 110,000 |
| Total ... | 1,015,000 |
| (iii) Protection of existing irrigation in the delta comprising— | |
| (*a*) First crop ... ... ... ... ... ... ... | 700,000 |
| (*b*) Divi project ... ... ... ... ... ... ... | 80,000 |
| | 780,000 |

In the preliminary project, no credit is taken for the areas (iii) *supra*, since it is only prospective diminution of supply owing to execution of works in the Bombay Presidency or in Native States, which will affect the area of 780,000.

12. The extent of the above areas shows as follows :—

(i) That the estimated area of first crop on the upland canal is nearly half of the whole increase, and provision of irrigation for this area is apparently necessary to justify large expenditure.

(ii) That the area of second crops on the upland canal is of minor importance, being only about 11 per cent. of the whole increase, while any attempt to secure this will necessitate continuous holding up of the water to a high level, barring scour of the silt deposits in the reservoir at least in the lower part.

(iii) That protection of the existing irrigation in the delta necessitates a large amount of extra storage being provided, but immediate provision may not be necessary, since no revenue credits are claimed in the financial statements. It appears undesirable to load the present scheme with the cost of insurances for existing irrigation works which should apparently be debited to these.

13. *Scheme of works.*—With no surveys and levels to refer to, and only general recollections of the Kistna valley, it is impossible for me to formulate quite definite suggestions ; however, to obviate delay in asking for and awaiting surveys and levels, I venture to hazard the following remarks :—

(i) The waters of the Kistna river will most probably be too turbid to admit of any one dam in the Pulichintala-Muktiala reach of the river, answering for all the areas detailed in paragraph 11 *supra* for a period of say 100 or 200 years ; I understand this is generally admitted to be the case, at least as far as present data go to show.

(ii) Assuming that no single work on the main river will meet general storage requirements, while also raising the water sufficiently for the upland canal, it appears advisable to consider the following alternatives :—

(*a*) Construction of a fairly low level dam or rather pick-up-weir of limited storage capacity in the Pulichintala-Muktiala reach of the river of a suitable height and in a suitable location as regards surplussing, to meet the following conditions :—

(1) Supply of water for the following *areas*—*vide* paragraph 11 *supra*—

200,000 + 205,000 + 500,000 = 905,000

(2) Surplussing to be on sound *napah* rock by some of the means indicated in my note, dated 3rd April 1909.

(3) Annual clearing out of the reservoir down to bed level by such occasional scouring in floods as will serve to make the reservoir remain efficient for 100 to 200 years. A work which will meet these requirements, may be unattainable as regards existence of facilities for surplussing on sound rock, the levels of the surplussing portion as compared with those of the canal, or the unavoidably limited area. It would be essential that the project should be productive.

(b) Failing the work (a) above promising to meet requirements to a reasonable extent, it may be considered how it will answer financially to supplement it with a large storage work located further up stream between Daida and Pulichintala; this work would be designed to admit of scouring out, while it would be operated in the manner indicated in paragraph 10 *supra*. The cost of the pick-up-weir (a) *supra* coupled with the cost of an open dam of the Assouan type, may be too great to admit of the work promising to be productive from irrigation of the areas given in paragraph 11 (i) and (ii) *supra*; if this is the case, it may then be considered what provision should be made for existing irrigation and what debit can, and should, be made for the same.

(iii) The construction of a reservoir solely for the delta will call for consideration of the surplussing question and also for provision for scouring; it appears doubtful if a case can be made out for such a work, if no debit against existing work is warrantable.

(iv) Is it advisable to proceed with the survey of the upland canal?

14. The proposals in paragraph (i) to (iii) *supra* can be considered by the local officers when the investigations and surveys connected with possible sites are completed.

15. With regard to the question (iv) *supra*, the original proposal was a high dam in the Pulichintala-Muktiala reach which would serve for storage and supply of the upland canal; since a work which will effect both these purposes, appears at present to be unattainable, I would advise consideration of the advisability of defering surveys of the high level canal. The offtake level could be fixed within fairly narrow limits under the previous proposals, and on this understanding I acquiesced in the canal survey being carried out; however, if the river work in this locality is only to be a pick-up-weir, the canal offtake level may have to be a good deal lower, and surveys for a canal at a considerably higher level might be of very little use. The surveys already executed may suffice for revenue survey purposes. It would appear desirable to carry out detailed alignment and sectioning *on the line which the canal will occupy*, and this will apparently depend on the work to be built in the river. For these reasons, it appears to me that the alignment and levelling of the canal should be deferred, so that labour may not be lost. I presume there is abundance of work for the establishment in the survey of sites for works on the river, or on the Cauvery project under the same Superintending Engineer.

16. *Storage reservoir.*—In the event of it being found that the works must comprise (i) a storage reservoir (ii) and a separate pick-up-weir, the latter should be sufficiently removed from the former, not to back water up on the storage dam; this appears to preclude any of the five sites opposite the Pulichintala answering for a storage site. The site at Daida, surveyed for the Tungabhadra project, was not found to be very favourable as regards probable cost and facility for securing land; it is very desirable to procure a site which will be freer from objections. In selecting a site, canal offtake requirements have not to be considered which may simplify the problem. I would venture to suggest that a reconnaissance of likely sites as shown by the topographical features on the best maps, may be made, and that detailed investigations may be carried out on such of these as appear to call for it. This will unavoidably involve considerable extra labour, but it appears essential for success to devise a scheme which will be free from the very serious objection of being short-lived.

---

## Appendix A.

*Extract from a note by Colonel W. M. Ellis, R.E., on the manner of executing the Kistna silt observations of* 1898—1900.

* * * * *

2. The measurements of silt in suspension were practically confined to the water after entering the canals (Eastern delta) and a series of regular observations were made for the years 1898, 1899, 1900 and for June and July 1901, when the observations were unfortunately discontinued. The nature of the observations taken in 1898 is clearly described in a note, dated 31st March 1899, by Mr. J. S. Wilson, a copy of which is attached.

3. Briefly the method of observations in 1898 was as under:—

A site in the centre of the main canal some 200 feet below the bridge which used to stand in the site of the present head sluice, was selected. Here samples of silt were taken at different depths by lowering a bamboo to the bottom with five corked bottles (quart bottles of capacity about $1\frac{1}{2}$ pints) attached at intervals, the top of the lowest bottle being 1 foot above canal bed. On reaching the bottom, the corks were withdrawn from the bottles by strings and the silty water at various depths filled the bottles. The bottles were raised and corked up. Each bottle was then

shaken and any excess water drawn off to a mark indicating a certain known capacity (Twenty ounces Apothecaries' weight, each ounce being 480 grains). About 1 grain of alum was added to each bottle which was left 24 hours to stand. The clear water was then syphoned off. The wet silt was poured into a copper pan and evaporated to dryness and weighed. The sum of all the weights gave the number of grains of silt in five bottles capacity and from this the number of lbs. per cubic foot of silt was computed.

Observations were taken every three or four days and the exact dates and results are all noted in the silt register which has been examined by me.

4. Similar observations were taken in subsequent years with the following minor deviations:—

(a) Observations were taken daily during the silt carrying period.

(b) A small chemical balance was used in place of the medicine scales used the first year.

(c) The contents of the bottles of silt taken at various depths were mixed before separating out and weighing the silt, so that the silt carried at different depths was not measured separately after 1898.

(d) Certain further observations of quantities of heavy (muddy settling) sands in the silt were made and recorded, but these do not affect the total quantities of silt now being reported on.

5. Inaccuracies in the results may have occurred from the primative character of the apparatus and in the first year (1898), through taking observations at intervals of three or four days.

Also the measurements of the quantity of water in each bottle might be 3 or 4 per cent. in error, as the file marks on the bottles were in the big part of the bottle.

An ascertained error was in counting 44 bottles to the cubic foot, whereas by actual measurement 45 bottles filled up to the mark were required to fill a cubic foot measure. By calculation I find the number of bottles required (20 oz. Apothecaries' weight) to fill a content of 1 cubic foot is 45·41 bottles. This introduces an error of about 2¼ per cent. and to eliminate this 2¼ per cent. should be added to the total quantity of silt given in the attached tables. I have not altered the registers, as our errors of observation will probably be much more than this and all that is put forward is that these observations give valuable and reliable results and the limit of error probably does not exceed 12 per cent.

## Appendix B.

| Month. | 1898. Discharge in cusecs. From To | 1898. Discharge in millions cubic feet. | 1898. Silt in millions cublic feet. | 1898. Proportion by volume. Silt/Water. | 1899. Discharge in cusecs. From To | 1899. Discharge in millions cubic feet. | 1899. Silt in millions cubic feet. | 1899. Proportion by volume. Silt/Water. | 1900. Discharge in cusecs. From To | 1900. Discharge in millions cubic feet. | 1900. Silt in millions cubic feet. | 1900. Proportion by volume Silt/Water. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| June .. .. .. .. | 94,312<br>310,805 | 151,078 | 591 | 1/256 | 57,034<br>148,941 | 77,754 | 261 | 1/297 | 14,788<br>120,940 | 59,977 | 459 | 1/130 |
| July .. .. .. .. | 34,931<br>516,191 | 519,236 | 736 | 1/704 | 50,676<br>222,048 | 264,095 | 228 | 1/1154 | 48,630<br>640,532 | 752,026 | 2,150 | 1/347 |
| August .. .. .. .. | 17,308<br>446,888 | 560,366 | 241 | 1/2333 | 21,707<br>74,344 | 119,823 | 34 | 1/3500 | 79,912<br>565,441 | 1,049,417 | 1,293 | 1/812 |
| September .. .. .. | 46,577<br>344,920 | 456,273 | 856 | 1/533 | 29,126<br>398,855 | 308,281 | 1,828 | 1/169 | 54,286<br>227,044 | 241,354 | 275 | 1/882 |
| October .. .. .. .. | 29,042<br>282,539 | 350,310 | 1,016 | 1/346 | 6,577<br>20,313 | 32,122 | 9 | 1/3293 | 15,034<br>226,683 | 160,928 | 161 | 1/1000 |
| November .. .. .. | ..<br>.. | 82,155 | 24 | 1/3394 | 5,926<br>7,157 | 5,287 | (0·2) | 1/31111 | 7,302<br>15,005 | 17,508 | 2 | 1/9333 |
| Total .. | .. | 2,119,418 | 3,464 | 1/611 | .. | 807,362 | 2,360 | 1/342 | .. | 2,281,210 | 4,340 | 1/526 |

## Appendix C.

| Month. | | Discharge in 1,000 cusecs. From 00 To 50 | 50 100 | 100 200 | 200 300 | 300 400 | 400 500 | 500 600 | 600 700 |
|---|---|---|---|---|---|---|---|---|---|
| | | Silt in pounds per cubic foot of water. | | | | | | | |
| June | 1898 | .. .. | .. | ·694/1 ·180/4 | ·560/4 | .. | .. | .. | .. |
| | 1899 | .. ·027/1 | ·161/4 | ·431/4 | .. | .. | ·182/8 | .. | .. |
| | 1900 | .. ·326/3 | ·720/3 | 1·070/3 | .. | .. | .. | .. | .. |
| July | 1898 | .. ·034/4 | ·051/4 ·076/4 | ·083/8 | ·151/3 | .. | ·132/1 ·191/7 | .. | .. |
| | 1899 | .. .. | ·097/4 ·037/7 ·037/9 | ·084/4 | ·175/7 | .. | .. | .. | .. |
| | 1900 | .. .. | ·560/3 | ·480/3 ·340/5 | ·170/5 ·130/3 | ·130/3 ·410/3 | ·250/2 | ·410/2 | ·510/2 |
| August | 1898 | .. | ·015/7 | ·023/7 ·151/1 | ·028/9 | ·080/7 | .. | .. | .. |
| | 1899 | ·011/17 ·018/2 | ·046/12 | .. | .. | .. | .. | .. | .. |
| | 1900 | .. .. | ·027/3 | ·190/4 ·038/2 | ·062/2 | .. | ·253/3 ·091/2 | ·132/15 | .. |
| September | 1898 | .. .. | ·059/3 | ·084/7 ·033/6 | ·228/7 | ·320/7 | .. | .. | .. |
| | 1899 | ·020/11 ·030/2 | 050/3 | ·413/3 | ·062/8 | 1·059/3 | .. | .. | .. |
| | 1900 | .. .. | ·028/10 ·093/12 | ·198/8 | .. | .. | .. | .. | .. |
| October | 1898 | .. ·035/6 | ·091/10 | ·258/3 ·138/1 | ·420/11 | .. | .. | .. | .. |
| | 1899 | .. ·023/31 | .. | .. | .. | .. | .. | .. | .. |
| | 1900 | .. ·044/20 | ·140/5 | ·104/4 | ·180/2 | .. | .. | .. | .. |
| November | 1898 | ·018/14 ·025/11 | ·050/5 | .. | .. | .. | .. | .. | .. |
| | 1899 | .. ·004/9 | .. | .. | .. | .. | .. | .. | .. |
| | 1900 | .. ·010/9 | .. | .. | .. | .. | .. | .. | .. |

**Order—No. 229 I., dated 2nd June 1909.**

The letter from the Government of India No. 544 I., dated 18th May 1909, last read above will be communicated to the officers concerned, in continuation of G.O., No. 200 I., dated 8th May 1909.

2. The attention of the Superintending Engineer on Special duty will be drawn to the instructions in Chief Engineer's Memorandum No. R.O.C. 28-O., dated 21st May 1909.

(True Extract.)

C. A. Smith,
*Joint Secretary to Government,*
*Irrigation Branch.*

To the Chief Engineer for Irrigation.
,, Superintending Engineer on Special duty.
,, Revenue Department.
,, Board of Revenue (Revenue Settlement).

Copy to the Superintending Engineer, II Circle (with a copy of G.O., No. 200 I., dated 8th May 1909).

# Government of Madras.

## PUBLIC WORKS DEPARTMENT.

IRRIGATION.
ACCOUNT.

*Recd.* } 1909. *Enclosures*

*Regd.* *Spare copies*

**G.O., Nos. $\frac{229}{A}$, $\frac{229}{B}$ I., 2nd June 1909.**

**Bridges of head lock of Bantumilli canal and Vinjaram lock of Polraz canal, Kistna Eastern Division**

Forwarding a copy of the Proceedings sanctioning, with remarks, estimates, aggregating Rs. 4,428, for raising the —.

No. $\frac{229}{A}$ I., 2nd June 1909.

GOVERNMENT OF MADRAS.

PUBLIC WORKS DEPARTMENT.

Irrigation.
Account.

Read—the following papers :—

I

*Letter*—from S. B. Murray, Esq., A.M.I.C.E., Superintending Engineer, II Circle.
*To*—the Chief Engineer for Irrigation.
*Dated*—Bezwada, the 12th April 1909.
*No.*—17 I.

I have the honour to forward herewith, for the sanction of Government, the following estimates :—

(1) Raising the bridge of head lock of Bantumilli canal at 36 miles 5 chains at Cowtaram, estimate Rs. 1,780.

(2) Raising the bridge of Vinjaram lock on Polraz canal at 52 miles 28 chains, estimate Rs. 1,820.

2. The reports accompanying the estimates explain the necessity for the works.

3. As the work has to be done during the closure, I have authorised the Executive Engineer to purchase the iron work in anticipation of sanction to the estimates and I request you will approve of my action.

Enclosures.

*Report to accompany the estimate for raising the lock bridge of head lock of Bantumilli canal at* 36 *miles* 5 *chains at Cowtaram.*

| | RS. |
|---|---|
| Estimate ... ... ... ... ... ... ... ... ... | 1,780 |

The present lock bridge over the Bantumilli canal at Cowtaram has a masonry arch, the crown of which is only 9′ 3″ above the F.S.L., in the canal ; consequently first-class staff boats can at times only pass with difficulty.

It is now proposed to dismantle the arch and parapet wall and erect a bridge of Westwood and Baillies Steel Trough Plates ⅜″ thick section G on page 204 of Richardsons and Cruddas' Catalogue.

A clear headway of 11 feet above M.C.L. is allowed.

The parapets and wings will be removed and rebuilt as shown on the plan.

As the present string course and coping are of cutstone they will be carefully removed and refixed. Hence labour alone is provided in the estimate.

The work will be done in accordance with the standard specifications current in the department.

Early sanction is requested so that the work can be carried out this closure. The iron work has been ordered in anticipation as approved by Superintending Engineer in his D.O., dated 15th March 1909.

*2nd April* 1909.

R. N. H. Reid,
*Executive Engineer, Kistna Eastern Division.*

*Report to accompany the estimate for raising the lock bridge of Vinjaram lock on Polraz canal at 52 miles, 28 chains.*

| | RS. |
|---|---|
| Estimate ... ... ... ... ... ... ... ... | 1,820 |

The present lock bridge over the Polraz canal at Vinjaram has a masonry arch, the crown of which is only 10·19 above the F.S.L. in the canal; consequently first-class staff boats can at times only pass with difficulty.

It is now proposed to dismantle the arch and parapet walls and erect a bridge of Westwood and Baillies Trough Plates ⅜" thick section G on page 204 of Richardson and Cruddas' Catalogue.

A clear headway of 11 feet above M.C.L. is allowed.

The parapets and wings will be removed and rebuilt as shown in the plan.

As the present string course and coping are of cutstones, they will be carefully removed and refixed. Hence labour alone is provided in the estimate.

Early sanction is requested so that the work can be carried out this closure. The iron work has been ordered in anticipation as approved by Superintending Engineer in his D.O., dated 15th March 1909.

*2nd April* 1909.

R. N. H. REID,
*Executive Engineer, Kistna Eastern Division.*

---

II

From the Superintending Engineer, II Circle, dated 27th May 1909, No. 81 I.

---

III

**Note by the Chief Engineer for Irrigation.**

The estimates received with the above letter are recommended for sanction.

2. The Superintending Engineer states that as the work has to be completed during the closure, he has authorised the Executive Engineer to purchase iron work in anticipation of sanction to the estimates. His action may under the circumstances be approved, but it may at the same time be pointed out that as the necessity for the alterations must have been known for some time, the estimate should have been submitted in sufficient time to enable sanction to be obtained before putting the work in hand.

*2nd June* 1909.

C. A. SMITH,
*Chief Engineer for Irrigation.*

---

**Order—No. $\frac{229}{A}$ I., dated 2nd June 1909.**

The following estimates are sanctioned :—

Imperial.
Capital expenditure not charged to Revenue.
49. Irrigation.
Kistna Delta System.
Eastern Division.
Open Capital Account.
I. Works.
2. Main Canals and Branches.
I. Navigation Works.
Unremunerative Work.

(1) Raising the bridge of head lock of Bantumilli canal at 36 miles 5 chains.

| | RS. |
|---|---|
| Estimate— | |
| I. Works ... ... ... ... ... ... ... ... | 1,780 |
| II. Establishment ... ... ... ... ... ... ... | 409 |
| Total ... | 2,189 |

No. $\frac{229}{A}$ I., 2ND JUNE 1909.

(2) Raising the bridge of Vinjaram lock on Polraz canal at 52 miles 28 chains.

| | RS. |
|---|---|
| Estimate— | |
| I. Works ... ... ... ... ... ... ... ... | 1,820 |
| II. Establishment ... ... ... ... ... | 419 |
| Total ... | 2,239 |

2. This sanction is registered as No. 33 I. of 1909–1910 and will expire on the 31st March 1910.

3. The Superintending Engineer's action referred to in paragraph 2 of the note by the Chief Engineer for Irrigation is approved and the Superintending Engineer's attention is drawn to the latter portion of this paragraph.

4. The following (ordinary) telegram will be sent to the Superintending Engineer, II Circle :—

"Your No. 17 I. [of] 12th April 1909. Estimate sanctioned".

5. Ordered that a copy of these Proceedings be forwarded to the Government of India for information.

[Here enter No. $\frac{229}{B}$ I., dated 2nd June 1909.]

(True Extract.)

C. A. SMITH,
*Joint Secy. to Govt., P.W.D.,*
*Irrigation Branch.*

To the Chief Engineer for Irrigation.
" Superintending Engineer, II Circle, with plans and estimates.
" Examiner, Public Works Accounts.

---

**Endorsement—No. $\frac{229}{B}$ I., dated 2nd June 1909.**

Forwarded.

(By Order.)

C. A. SMITH,
*Joint Secy. to Govt., P.W.D.,*
*Irrigation Branch.*

# Government of Madras.

## PUBLIC WORKS DEPARTMENT.

IRRIGATION.
ACCOUNT.

*Recd.* } 1909. *Enclosures*

*Regd.* *Spare copies*

## G.O., No. 230 I., 5th June 1909.

### Floating Plant

Directing, with remarks, that small estimates for — except those for staff boats, or boats for which rent or hire is payable, be dealt with by Superintending Engineers up to a limit of Rs. 1,000.

GOVERNMENT OF MADRAS.

PUBLIC WORKS DEPARTMENT.

**Irrigation.**
**Account.**

Read—the following papers:—

I

**G.O., No. 119 I., dated 24th January 1902.**
**" " 659 I. " 15th June 1904.**

II

| | | | | | |
|---|---|---|---|---|---|
| From the Superintending Engineer, | VI Circle, | dated | 31st May | 1908, | No. 297-C.E. |
| " " | II " | " | 10th Sept. | " | " 252-I. |
| " " | VI " | " | 15th Dec. | " | " 712-C.E. |

III

**Note by the Chief Engineer for Irrigation.**

With reference to the note embodied in G.O., No. 659 I., dated 15th June 1904, estimates for all kinds of floating plant have hitherto been submitted by Superintending Engineers to this office for the sanction of Government. The Superintending Engineers, II and VI Circles, having in their letters represented that it is anomalous to submit small estimates for dinghies and other similar plant, it is now considered that, in future, only estimates for staff boats, or boats for which rent or hire is payable, need be submitted for such sanction, irrespective of their cost, and that estimates for all other floating plant may be dealt with by the Superintending Engineers up to a limit of Rs. 1,000.

2. In exercising their powers as regards ferry ballacuts, Superintending Engineers will be careful to see that the villagers concerned agree to maintain the necessary staff for working them

C. A. Smith,
*Chief Engineer for Irrigation.*

27*th May* 1909.

**Order—No. 230 I., dated 5th June 1909.**

The proposals of the Chief Engineer for Irrigation are approved.

2. The attention of the Superintending Engineers is drawn to paragraph 2 of the foregoing note.

(True Extract.)

C. A. SMITH,
*Joint Secy. to Govt., P.W.D.,*
*Irrigation Branch.*

To all Superintending Engineers.
" the Chief Engineer for Irrigation.
" the Examiner, Public Works Accounts.
" the Superintending Engineer on Special duty,
Kistna and Cauvery Reservoir projects.

# Government of Madras.

## PUBLIC WORKS DEPARTMENT.

IRRIGATION.
ACCOUNT.

| | | |
|---|---|---|
| *Recd.* | 1909. | *Enclosures* |
| *Regd.* | | *Spare copies* |

## G.O., Nos. 231, $\frac{231}{A}$ I., 5th June 1909.

### Rest-house at Peranai, Periyar System

Forwarding, for information, a copy of the proceedings sanctioning an estimate of Rupees 1,943 for improvements to the —.

No. 231 I., 5TH JUNE 1909.

GOVERNMENT OF MADRAS.

PUBLIC WORKS DEPARTMENT.

---

**Irrigation.**
**Account.**

READ—the following papers :—

I

*Letter*—from H. E. CLERK, Esq., Superintending Engineer, VI Circle.
*To*—the Chief Engineer for Irrigation.
*Dated*—Trichinopoly, the 25th February 1909.
*No.*—161 C.E.

I have the honour to forward herewith, for your approval and sanction of Government, an estimate, amounting to Rs. 1,580, for improvements to the Inspection Bungalow at Peranai in the Madura district.

2. The improvements proposed consist of the construction of two additional rooms and the extension and widening of the existing verandah as shown on the enclosed tracing.

3. Owing to the importance of the head works at Peranai consequent on the development of irrigation under the Periyár system it very often happens that more than one officer encamps at Peranai at the same time and the bungalow as now exists is not large enough for its purpose. I am therefore of opinion that the improvements now proposed are very necessary and the estimate herewith forwarded is recommended for sanction.

4. The Collector of Madura who was asked to give his opinion in the matter has said that he is in favour of the improvements proposed (please *vide* copy of his letter No. D. Dis. 2878/Rev., dated 10th August 1908, attached to the estimate).

5. As the proposed work should, under Public Works Code, paragraph 1919, II-i, be classed as unremunerative one, I recommend that it be sanctioned against the Revenue account of the project under G.O., No. 404 I., dated 5th May 1899.

---

ENCLOSURES.

*Improvements to the Rest-house at Peranai.*

| | RS. |
|---|---|
| Amount of estimate ... ... ... ... ... ... ... | 1,580 |

The Peranai bungalow has one front room communicating with a bed room to which is attached two bath rooms; only one officer can be accommodated in it at a time. The front verandah is a thatched pandal, 6½ feet wide, on round posts; as it has to be renewed, the matter was brought to the Superintending Engineer's notice and that officer ordered this estimate to be made out. A new verandah, 10 feet wide, with burnt stone pillars with an additional room and bath-room will be added to the bungalow. This additional accommodation is required, as Peranai is becoming more important with the expansion of the Periyár system and also with the completion of the new Vaigai bridge, which will bring Peranai on to one of the rough routes of communication of the district. Please see copy of Collector's letter enclosed.

2. The extension will be partly on a piece of paddy land lately acquired. The ground is lower than the rest of the compound, it is being levelled with silt from the main canal. The old stones from the recently dismantled old head sluice will be used in the work except the items, lintels over doors and windows and pillars for the verandah.

*14th September 1908.*

R. DECHAZAL,
*Executive Engineer, Madura Division.*

*Letter*—from H. F. W. Gillman, Esq., I.C.S., Collector of Madura.
*To*—the Executive Engineer, Madura Division.
*Dated*—the 10th August 1908.
*No.*—D. Dis. 2878/Rev.

With reference to your No. 1139/M., dated 9th July 1908, I have the honour to state that the proposed additional accommodation, if provided, will be of use to officers of other departments also.

---

II

**Memorandum R.C. No. 14, dated 3rd May 1909.**

With reference to his letter No. 161 C.E., dated 25th February 1909, forwarding an estimate for improvements to the Inspection Bungalow at Peranai, the Superintending Engineer, VI Circle, is requested to report if he is quite satisfied that the work can be done for the rates allowed in the estimate. They appear in some cases to be too low.

C. A. Smith,
*Chief Engineer for Irrigation.*

To the Superintending Engineer, VI Circle.

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III

*Letter*—from H. E. Clerk, Esq., Superintending Engineer, VI Circle.
*To*—the Chief Engineer for Irrigation.
*Dated*—Trichinopoly, the 15th May 1909.
*No.*—407 C.E.

In reply to your R.C. No. 14, dated 3rd May 1909, I have the honour to inform you that the work of improvements to the Inspection Bungalow at Peranai can be done at the rates entered in the estimates. The rates for masonry and concrete appear low as materials are available from the old head sluice recently demolished, as stated in the data sheet attached to the estimate. The estimate may, therefore, as submitted be sanctioned.

---

IV

**Note by the Chief Engineer for Irrigation.**

The estimate is recommended for sanction under the Open Capital Account of the Periyár system with reference to paragraph 1920 (*c*) of the Public Works Department Code.

25*th May* 1909.

C. A. Smith,
*Chief Engineer for Irrigation.*

---

**Order—No. 231 I., dated 5th June 1909.**

The following estimate is sanctioned :—

Imperial.
Capital Expenditure not charged to Revenue.
49. Irrigation.
Periyár System.
Open Capital Account.
I. Works.
1. Head Works.
K. Buildings.
Unremunerative Work.
Improvements to the rest-house at Peranai.

**Estimate—**

| | RS. |
|---|---|
| I. Works ... ... ... ... ... ... ... ... | 1,580 |
| II. Establishment ... ... ... ... ... ... ... | 363 |
| | 1,943 |

2. This sanction is registered as No. 30 I. of 1909-1910 and will expire on the 31st March 1910.

3. Ordered that a copy of these proceedings be forwarded to the Government of India for information.

[Here enter No. $\frac{231}{A}$ I., dated 5th June 1909.]

(True Extract.)

C. A. Smith,
*Joint Secy. to Govt., P.W.D.,*
*Irrigation Branch.*

To the Chief Engineer for Irrigation.
" Superintending Engineer, VI Circle, with plan and estimate.
" Examiner, Public Works Accounts.

---

**Endorsement—No. $\frac{231}{A}$ I., dated 5th June 1909.**

Forwarded.

(By Order.)

C. A. Smith,
*Joint Secy. to Govt., P.W.D.,*
*Irrigation Branch.*

# Government of Madras.

## PUBLIC WORKS DEPARTMENT.

IRRIGATION.

*Recd.* } 1909. *Enclosures*

*Regd.* *Spare copies*

## G.O., No. 232 I., 5th June 1909.

### Establishment

Approving, with remarks, the recommendation of the Chief Engineer for Irrigation for the temporary entertainment of a Revenue Inspector and a peon to collect statistics showing the areas irrigated in each month under wet and dry crops in the Kistna Western division.

GOVERNMENT OF MADRAS.

PUBLIC WORKS DEPARTMENT.

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**Irrigation.**

Read—the following papers :—

I

**G.O., No. 182 I., dated 28th April 1909.**

Abstract.—Stating that Government are making special arrangements for gauging canals and distributaries to ascertain the duty of water; requesting the Collector of Kistna to depute a suitable Revenue Inspector to collect statistics to show areas irrigated in each month under wet and dry crops in the Kistna Western division; and stating that further detailed instructions for the guidance of the Executive Engineer will be issued by the Chief Engineer for Irrigation.

# II

**Statement of proposition for revision of establishment.**

| Serial Item number. | Order sanctioning present establishment. Government of Madras, Public Works Department. No. | Date. | Office to which the proposition refers. | Nature of changes. Present scale. Number. | Designation. | Pay. Minimum. | Increment. | Maximum. | Average or fixed. | Total cost. | Proposed scale. Number. | Designation. | Pay. Minimum. | Increment. | Maximum. | Average or fixed. | Total cost. | Proposition. Permanent. Increase per month. Amount. | Decrease per month. Amount. | Temporary. Increase per month. Period. | Amount. | Decrease per month. Period | Amount. | Remarks. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | TEMPORARY ESTABLISHMENT FOR 1909–1910. | | | | RS. | RS. | | TEMPORARY ESTABLISHMENT FOR 1909–1910. | | | | RS. | RS. | | | MON. | RS. | | | |
| | | | | | *Division office.* | | | | | | | *Division office.* | | | | | | | | | | | | |
| 1 | No. 468 W. | 23rd April 1909. | Kistna Western Divn. | 2 | Draftsmen for 12 months on Rs. 30 each. | .. | .. | .. | 2×30 | 720 | 2 | Draftsmen for 12 months on Rs. 30 each. | .. | .. | .. | 2×30 | 720 | .. | .. | .. | .. | .. | .. | |
| 2 | | | | 1 | Clerk for Division office for 12 months. | .. | .. | .. | 15 | 180 | 1 | Clerk for Division office for 12 months. | .. | .. | .. | 15 | 180 | .. | .. | .. | .. | .. | .. | |
| 3 | | | | 1 | Do. do. | .. | .. | .. | 20 | 240 | 1 | Do. do. | .. | .. | .. | 20 | 240 | .. | .. | .. | .. | .. | .. | |
| | | | | | *Appapuram Project sub-division.* | | | | | | | *Appapuram Project sub-division.* | | | | | | | | | | | | |
| 4 | | | | 1 | Clerk for 12 months .. | .. | .. | .. | 30 | 360 | 1 | Clerk for 12 months .. | .. | .. | .. | 30 | 360 | .. | | .. | .. | .. | .. | |
| 5 | | | | 1 | Peon for 12 months .. | .. | .. | .. | 8 | 96 | 1 | Peon for 12 months .. | .. | .. | .. | 8 | 96 | .. | .. | .. | .. | .. | .. | |
| 6 | | | | 3 | Peons for 12 months on Rs. 7 each. | .. | .. | .. | 3 × 7 | 252 | 3 | Peons for 12 months on Rs. 7 each. | .. | .. | .. | 3 × 7 | 252 | .. | .. | .. | .. | .. | .. | |
| .. | | | | | .... | .. | .. | .. | .. | .. | 1 | Revenue Inspector for 6 months. | .. | .. | | 50 | 300 | .. | .. | 6 | 50 | .. | .. | Required in Kistna Western division to check the accuracy of the statistics, showing the areas irrigated in each month under wet and dry crops—see G.O., No. 182 I., dated 28th April 1909. |
| .. | | | | | .... | .. | | .. | .. | .. | 1 | Peon under Revenue Inspector for 6 months. | .. | .. | .. | 7 | 42 | .. | .. | 6 | 7 | .. | .. | |
| | | | | | Total .. | .. | .. | .. | .. | 1,848 | | Total .. | .. | .. | .. | .. | 2,190 | .. | .. | .. | .. | | .. | |

**No. 56 I., dated 10th May 1909.**

Forwarded to the Chief Engineer for Irrigation for favour of sanction with reference to paragraph 4 of G.O., No. 182 I., dated 28th April 1909.

S. B. Murray,
*Superintending Engineer, II Circle.*

### III

**Note by the Chief Engineer for Irrigation, dated 24th May 1909.**

The proposition statement is recommended for sanction.

C. A. SMITH,
*Chief Engineer for Irrigation.*

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**Order—No. 232 I., dated 5th June 1909.**

The recommendation of the Chief Engineer for Irrigation is approved.

2. The amount required to meet the cost of the special establishment will be met from the grant made under the head "42. Major Works (Working expenses)" for the Kistna delta system.

(True Extract.)

C. A. SMITH,
*Joint Secretary to Govt., P.W.D.,*
*Irrigation Branch.*

To the Chief Engineer for Irrigation.
,, Superintending Engineer, II Circle.
,, Examiner, Public Works Accounts.
,, Revenue Department.
,, Board of Revenue (Revenue Settlement).
,, Collector of Guntúr.

# Government of Madras.

## PUBLIC WORKS DEPARTMENT.

IRRIGATION.
ACCOUNT.

| | | |
|---|---|---|
| *Recd.* | 1909. | *Enclosures* |
| *Regd.* | | *Spare copies* |

## G.O., No. 233 I., 5th June 1909.

**Grade-wall and Regulator at the head of the Singiam Branch Channel, Coimbatore District**

An estimate, amounting to Rs. 1,843, for constructing a —, sanctioned.

GOVERNMENT OF MADRAS.

PUBLIC WORKS DEPARTMENT.

**Irrigation.**
**Account.**

Read—the following papers :—

I

| | | | | | |
|---|---|---|---|---|---|
| From the Superintending Engineer, | IV Circle, | dated | 12th December 1908, | No. | 282 I. |
| To the " | IV " | " | 10th February 1909 | " | 477. |
| From the " | IV " | " | 1st March " | " | 49 I./411 B. |

Enclosure.

*Report to accompany the estimate for constructing a grade-wall and regulator at the head of Singiam branch channel of Thadapalle Channel.*

| | RS. |
|---|---|
| Amount of estimate ... ... ... ... ... ... ... | 1,500 |

It is proposed in the accompanying estimate to construct a grade-wall and regulator at the open head of the Singiam channel taking off to the right of Thadapalle channel at 15/3 miles.

The channel is for irrigating 430 acres of kar lands being opened on the 23rd June each year and closed after four months. At present the channel is closed by throwing a mud dam at the head of the channel which tends to silt up the channel and which is inefficient in keeping out water from the Singiam channel when not wanted.

2. As the fall of the Singiam channel is 1 foot per mile and the fall of the Thadapalle channel at the site is 3′ per mile on an average, water flows more easily along the Thadapalle channel than along the Singiam channel and a grade-wall across the Thadapalle channel with floor 6″ higher than the sill of Singiam regulator has been added so that an equitable distribution of water between the Thadapalle and the Singiam channels proportionate to their ayacut may be obtained. The vent ways have been designed for free flow along both the Thadapalle and Singiam channels at the site of the regulator.

3. The rates allowed in the estimate are those usually allowed in the Thadapalle channel and maintenance estimates.

H. T. Keeling,
*Executive Engineer, Coimbatore Division.*

II

**Note by the Chief Engineer for Irrigation.**

With his letter No. 282-I., dated 12th December 1908, the Superintending Engineer, IV Circle, submits an estimate, amounting to Rs. 1,500, for constructing a grade-wall and regulator at the head of the Singiam branch channel taking off at 15 miles 3 furlongs of the Thadapally channel, Coimbatore district.

2. It is stated—

(*a*) that the Singiam branch channel, which irrigates 430 acres, has an open head with a bed fall of 1 foot per mile and that as the main channel at the site has a fall of 3 feet per mile water flows along it more easily than along the branch channel, and

(*b*) that the branch channel is, at present, closed by throwing a mud dam at its head, when no water is required and this tends to silt up the branch, besides being

inefficient in keeping out water from it. For the above reasons it is proposed to construct a regulator at the head of the Singiam branch channel with a water-way of 5′ × 4½′ regulated by screw gearing shutter and a grade-wall across the main channel having a bottom width of 27 feet and slopes 1 to 1 with its floor 6 inches above the sill of the regulator, in order to secure an equitable distribution of water proportionate to their ayacuts.

The estimate has been countersigned by the Collector and is recommended for sanction.

21*st May* 1909.

C. A. SMITH,
*Chief Engineer for Irrigation.*

---

**Order—No. 233 I., dated 5th June 1909.**

The following estimate is sanctioned :—

Provincial.
Irrigation.
43. Minor Works and Navigation.
Class II—Minor works for which Capital and Revenue Accounts are kept.
Thadapalle Channel System.
Open Capital Account.
I. Works.
2. Main Canals and Branches.
D. Regulators.

Constructing a grade-wall and regulator at the head of Singiam Branch channel.

| | | RS. |
|---|---|---|
| Estimate | I. Works ... ... ... ... ... ... ... | 1,500 |
| | II. Establishment ... ... ... ... ... ... | 343 |
| | Total ... | 1,843 |

2. This sanction is registered as No. 31 I. of 1909–1910 and will expire on the 31st March 1910.

(True Extract.)

C. A. SMITH,
*Joint Secy. to Govt., P. W. D.,*
*Irrigation Branch.*

To the Chief Engineer for Irrigation.
" Superintending Engineer, IV Circle (with plans and estimate).
" Examiner, Public Works Accounts.

# Government of Madras.

PUBLIC WORKS DEPARTMENT.

IRRIGATION.

| | | | |
|---|---|---|---|
| *Recd.* | } 1909. | | *Enclosures* |
| *Regd.* | | | *Spare copies* |

## G.O., No. 234 I., 5th June 1909.

**Composite Punts in the Kistna Central Division**

The sale by public auction of the unserviceable —, sanctioned with remarks.

GOVERNMENT OF MADRAS.

# PUBLIC WORKS DEPARTMENT.

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## Irrigation.

READ—the following papers:—

I

*Letter*—from S. B. MURRAY, Esq., A.M.I.C.E., Superintending Engineer, II Circle.
*To*—the Chief Engineer for Irrigation.
*Dated*—Bezwada, the 4th May 1909.
*No.*—44 I.

I have the honour to forward for your orders a survey report on 23 composite Punts which are on the books of the Kistna Central division. All these punts, which have an iron (or steel) frame-work, and teakwood hulls, were built between 1876—1889. I have seen all, or almost all, of them, and I can say without hesitation that they are unserviceable. Most of them have been sunk in the Main or Ellore canal for years.

2. I request early orders about the disposal of these punts, which I suggest should be sold by auction as they lie. If they are not disposed of before the opening of the canals, they will remain where they are and block the waterway for another year.

3. I shall forward proposals for replacing these derelicts.

4. I request that you will attach no importance to the so-called "present book value" of these punts. The figures are purely imaginary as will be seen by a reference to item 8 in the survey report.

ENCLOSURE.

# KISTNA CENTRAL DIVISION.

## Report of the survey of stores which have become unserviceable.

| Number or quantity. | Description of articles. | Value on the books. Original value. | Value on the books. Present book value. | Date of receipt. | When last repaired, with cost. | Remarks by the subordinate in charge explaining the cause of the articles becoming unserviceable. | Remarks by the Executive Engineer. | Orders of the Superintending Engineer. |
|---|---|---|---|---|---|---|---|---|
| | | RS. | RS. | | | | | |
| 1 | Composite punt No. 17 .. .. | 3,000 | 900 | 1876-77 .. | August 1908, Rs. 208 .. | Leaky. Idle at Muthyalampad. | | |
| 2 | Do. No. 18 .. .. | 3,000 | 263 | 1877-78 .. | November 1908, Rs. 219 .. | Not working being leaky. Sunk at Main canal near new boatyard. | | |
| 3 | Do. No. 19 .. .. | 3,000 | 1,600 | 1877-78 .. | October 1907, Rs. 195 .. | Leaky. Sunk at Muthyalampad. | | |
| 4 | Do. No. 20 .. .. | 2,600 | 1,320 | 1882-83 .. | August 1908, Rs. 184 .. | Leaking badly. | | |
| 5 | Do. No. 23 .. .. | 2,600 | 1,320 | 1883-84 .. | ,, ,, ,, 258 .. | Do. | | |
| 6 | Do. No. 24 .. .. | 2,600 | 560 | 1883-84 .. | ,, ,, ,, 109 .. | Do. | | |
| 7 | Do. No. 26 .. .. | 3,811 | 2,430 | 1889-90 .. | October 1907, Rs. 243 .. | Sunk at Muthyalampad. | | |
| 8 | Do. No. 28 .. .. | 2,500 | 2,544 | 1876-77 .. | September 1908, Rs. 165 .. | Not working being leaky. Sunk at Main canal near new boatyard. | | |
| 9 | Do. No. 29 .. .. | 2,500 | .. | 1876-77 .. | February 1908, Rs. 142 .. | Sunk at Muthyalampad. | | |
| 10 | Do. No. 30 .. .. | 2,500 | 250 | 1877-78 .. | August 1908, Rs. 75, and February 1908, Rs. 141. | Received from Kistna Western division, leaky, on 27th January 1909. | | |
| 11 | Do. No. 32 .. .. | 2,287 | 142 | 1882-83 .. | February 1908, Rs. 162 .. | Sunk at Muthyalampad. | | |
| 12 | Do. No. 33 .. .. | 2,287 | 374 | 1881-82 .. | February 1907, Rs. 179 .. | Returned from Kistna Western division on 8th December 1908, leaky. | | |
| 13 | Do. No. 37 .. .. | 2,160 | 928 | 1883-84 .. | August 1908, Rs. 179 .. | Do. do. | | |
| 14 | Do. No. 27 .. .. | 2,553 | 1,298 | 1889-90 .. | August 1908, Rs. 214 .. | Sunk at Muthyalampad. | | |
| 15 | Do. No. 35 .. .. | 2,160 | 216 | 1883-84 .. | October 1907, Rs. 158 .. | Do. | | |
| 16 | Do. No. 39 .. .. | 1,900 | 330 | 1884-85 .. | August 1908, Rs. 134 .. | Returned from Kistna Western division on 8th December 1908. Very much leaking. | | |
| 17 | Do. No. 40 .. .. | 2,013 | 410 | 1885-86 .. | January 1908, Rs. 159 .. | Sunk at Muthyalampad. | | |
| 18 | Do. No. 41 .. .. | 2,075 | 441 | 1885-86 .. | August 1908, Rs. 73, and February 1908, Rs. 128. | Returned from Kistna Western division on 8th December 1908, leaky. | | |
| 19 | Do. No. 45 .. .. | 2,168 | 951 | 1886-87 .. | August 1908, Rs. 185 .. | Leaking badly. | | |
| 20 | Do. No. 46 .. .. | 2,169 | 952 | 1886-87 .. | February 1908, Rs. 123 .. | Hauled up at Muthyalampad. | | |
| 21 | Do. No. 47 .. .. | 2,164 | 948 | 1886-87 .. | November 1908, Rs. 198 .. | Leaking badly. | | |
| 22 | Do. No. 48 .. .. | 2,266 | 1,039 | 1889-90 .. | August 1908, Rs. 64, and February 1908, Rs. 128. | Do. | | |
| 23 | Do. No. 49 .. .. | 2,238 | 1,066 | 1889-90 .. | August 1908, Rs. 168 .. | Returned from Kistna Western division on 8th December 1908, leaky. | | |

*N.B.*—All the above punts are very old between 25 and 30 years and are unserviceable. Most of the ribs are corroded and very thin. The hull planks are rotten in several places and are of short lengths. The efficient repairs of these punts costs prohibitive. About Rs. 250 on an average per year has been spent for each punt, but soon after a punt is thus repaired and loaded with any materials, it is found that the whole punt sags and the pitch and coir come out and the punt starts leaking badly.

The Executive Engineer, Kistna Western division, to whom some of these punts were sent after repairs reported that he could not get crews to work them, because of their unserviceable condition due to leakage. I consider that any more outlay on repairs to these punts is a waste and the best thing, in my opinion, is to dismantle and stock all useful materials and auction the remainder or to auction the punts wholesale. The former method may be adopted for half.

Early action appears necessary as the whole of the boat-repairing place has been occupied by these irreparable punts.

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Submitted to Executive Engineer, Kistna Central division, with reference to his Nos. 357 W., dated 16th February 1909, and 382 W., dated 25th February 1909.

*15th March 1909,* W. T. J. SCANLON, *Sub-Divisional Officer, Shops.*

*27th March 1909.* H. F. DAWSON, *Executive Engineer.*

S. B. MURRAY, *Superintending Engineer.*

II

**Note by the Chief Engineer for Irrigation, dated 28th May 1909.**

With the letter read above the Superintending Engineer, II Circle, submits a survey report on the unserviceable composite punts in the Kistna Central division and applies for sanction to their disposal by public auction. It is recommended that the sanction sought for may be accorded.

2. As regards paragraph 4 of his letter quoted above, the Superintending Engineer may be informed that the excess in the "present book value" over the "original value" of punt No. 28 (old No. 44) is due to the expenditure on special repairs having exceeded the estimated amount of expenditure on it approved in G.O., No. 957 I., dated 30th August 1904. In this connection the Superintending Engineer's attention may, however, be drawn to paragraph 4 of the letter of the Executive Engineer, Kistna Eastern division, No. 2326, dated 31st July 1890, printed with G.O., No. 542 I., dated 26th September 1890, for arriving at the existing book value of the punts of this nature.

It is observed that no less than Rs. 2,294 was spent on special repairs to this punt in 1906–1907 and 1907–1908, in spite of which the punt is now reported to be useless, and requires further explanation.

C. A. Smith,
*Chief Engineer for Irrigation.*

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**Order—No. 234 I., dated 5th June 1909.**

The sale by public auction of the unserviceable composite punts in the Kistna Central division is sanctioned.

2. The attention of the Superintending Engineer, II Circle, is drawn to paragraph 2 of the note by the Chief Engineer for Irrigation.

(True Extract.)

C. A. Smith,
*Joint Secretary to Govt., P.W.D.,*
*Irrigation Branch.*

To the Chief Engineer for Irrigation.
,, Superintending Engineer, II Circle.
,, Examiner, Public Works Accounts.

# Government of Madras.

## PUBLIC WORKS DEPARTMENT.

IRRIGATION.

*Recd.* } 1909. *Enclosures*

*Regd.* *Spare copies*

## G.O., No. 235 I., 5th June 1909.

**Gauge readings of floods at the Kistna Railway Station**

Letter from the Agent, Great Indian Peninsula Railway Company, Bombay, stating that instructions have been issued to have the -- telegraphed to the Collector of Kistna and the Tahsildar of Divi, communicated to officers concerned.

GOVERNMENT OF MADRAS.

# PUBLIC WORKS DEPARTMENT.

## Irrigation.

Read—the following papers :—

I

**G.O., No. 132 I., dated 20th March 1909.**

II

*Letter*—from the Hon'ble Mr. W. L. Cameron, c.s.i., Secretary to the Government of Bombay, Public Works Department (Railway).

*To*—the Joint Secretary to the Government of Madras, Public Works Department, Irrigation Branch.

*Dated*—Bombay Castle, the 17th May 1909.

*No.*—676 Ry. of 1909.

I am directed to state that your letter No. 133 I., dated the 20th March 1909 (received in this department on the 13th May 1909), requesting that it may be arranged with the Great Indian Peninsula Railway authorities to have the readings of the gauge at the Kistna Railway station telegraphed to the Collector of Kistna, Masulipatam, and the Tahsildar of Divi at Avanigedda, has been forwarded to the Agent, Great Indian Peninsula Railway Company, for disposal in direct correspondence with you.

2. In this connection, I am to point out that, from the 1st January 1908, the date of the introduction of the revised procedure for the conduct of Railway business in India, the Government of Bombay do not exercise any administrative control over the Great Indian Peninsula Railway, and to request that if His Excellency the Governor of Madras in Council sees no objection, you will be so good as to address in future similar communications to the Railways concerned direct.

III

*Letter*—from F. J. Clark, Esq., Acting Secretary, Agent's Office, Great Indian Peninsula Railway Company.

*To*—the Joint Secretary to the Government of Madras, Public Works Department, Irrigation Branch.

*Dated*—Bombay, the 19th May 1909.

*No.*—4-F./4.

Referring to your letter No. 133 I., dated 20th March 1909, to the Secretary to the Government of Bombay, Public Works Department (Railway Branch), which has been sent to this office for disposal, I have the honour to inform you that instructions have been issued for the gauge readings of floods at the Kistna Railway station to be also communicated to the Collector of Kistna, Masulipatam, and to the Tahsildar of Divi at Avanigedda, as desired.

**Order—No. 235 I., dated 5th June 1909.**

Communicated to the officers concerned for information in continuation of G.O., No. 132 I., dated 20th March 1909.

(True Extract.)

C. A. SMITH,
*Joint Secretary to Govt., P.W.D.,*
*Irrigation Branch.*

To the Chief Engineer for Irrigation.
,, Superintending Engineer, II Circle.
,, Examiner, Public Works Accounts.
,, Revenue Department.

# Government of Madras.

## PUBLIC WORKS DEPARTMENT.

IRRIGATION.
ACCOUNT.

*Recd.* } 1909. *Enclosures.*

*Regd.* *Spare copies.*

## G.O., No. 236 I., 5th June 1909.

**Peddapasupula channel, Cuddapah district**

A supplemental estimate, amounting to Rs. 4,890, for improvements to the — sanctioned with remarks.

GOVERNMENT OF MADRAS.

PUBLIC WORKS DEPARTMENT.

**Irrigation.**
**Account.**

Read—the following papers :—

I

**G.O., No. 940 I., dated 6th December 1901.**

II

**G.O., No. 355 I., dated 3rd October 1908.**

III

*Letter*—from A. C. Langston, Esq., A.M.I.C.E., Officiating Superintending Engineer, III Circle.

*To*—the Chief Engineer for Irrigation.

*Dated*—Camp Cuddapah, the 24th March 1909.

*No.*—1952.

In reference to G.O., No. 355 I., dated 3rd October 1908, I have the honour to forward herewith, for favour of sanction of Government, a consolidated estimate amounting to Rs. 4,890 for bringing the Peddapasupula channel in working order in Jammalamadugu taluk of the Cuddapah district.

Enclosure.

*Report to accompany the estimate for supplemental works in connection with the excavation of Peddapasupula channel in Jammalamadugu taluk, Cuddapah district.*

| | RS. |
|---|---|
| Amount of estimate ... ... ... ... ... ... ... | 4,890 |

The excavation of the Peddapasupula channel was started during the famine of 1897 as per G.O., No. 314 I., dated 23rd March 1897, and the amount spent on famine labour was Rs. 47,527, the nominal value of work turned out being Rs. 8,127. Later on some supplemental masonry works were sanctioned at a cost of Rs. 34,000 completed by the year 1905–1906. The details of

works sanctioned and carried out as above described are excavation of main channel and distributaries and the required masonry works for necessary cross drainages and road culverts. In order to make the channel in working order, the following supplemental works are necessary:—

(1) Excavation of a leading channel in the river-bed about one mile long at a probable cost of Rs. 1,400 to enable spring water to reach the channel.

(2) Clearing silt above the head sluice at a cost of Rs. 40.

(3) Excavation of field channels from two distributaries costing Rs. 990.

(4) Insertion of pipes at the heads of the distributaries costing Rs. 530.

(5) Clearance of silt in the channel since 1906 up to date including item No. 2 costing Rs. 1,970.

The ryots agreed to bear the cost of items Nos. 1 and 3 first as per report of the Deputy Collector forwarded with Collector's No. 4254, dated 30th December 1906, embodied in G.O., No. 355 I., dated 3rd October 1908, but when they were asked to deposit the amount, the Collector in his No. 2452-Rev., dated 14th July 1908, informed the Superintending Engineer that the ryots wanted all the works to be done first by the Government and the cost recovered from such parties who took water, penalty for non-payment being refusal of water. Under such circumstances, the Government in G.O., No. 355 I., dated 3rd October 1908, called for an estimate for all the works required to keep the channel in working order. Accordingly a plan and estimate have been prepared for all the items stated above and are submitted for favour of approval and sanction.

*Specification.*—The work will be carried out according to the standard specifications.

*15th December* 1908.

D. S. SANKARA AIYAR,
*Sub-Divisional Officer, Proddatur Sub-Dn.*

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IV

**Note by the Chief Engineer for Irrigation.**

The papers read above relate to the Peddapasupula channel, the excavation of which was started during the famine of 1897 in Jammalamadugu taluk, Cuddapah district. The particulars of the channel, the work already carried out and that still to be done for bringing the channel in working order are explained in detail in G.O., No. 355 I., dated 3rd October 1908.

2. As instructed in paragraph 6 of the note by the Chief Engineer for Irrigation embodied in the Government Order referred to above, the Superintending Engineer, III Circle, now submits an estimate, amounting to Rs. 4,890, for the works required to bring the channel in operation. The estimate provides for—

| | RS |
|---|---|
| (1) Excavating a leading channel about a mile long in the river-bed ... ... ... ... ... ... ... ... | 1,400 |
| (2) Clearing silt in the channel ... ... ... ... ... | 1,970 |
| (3) Excavating field channels ... .. ... ... ... | 675 |
| (4) Constructing 10 pipe sluices and 9 slab culverts ... ... | 845 |
| Total ... | 4,890 |

The proposed leading channel from its starting point, at about 400 feet above the head sluice, to its head in the river-bed is 5,600 feet long, of which the first 4,800 feet above the sluice will have a bed width of 6 feet, slopes $1\frac{1}{2}$ to 1 and bed fall 2·12 feet per mile to discharge with $1\frac{1}{2}$ feet depth, 12 cusecs, being the quantity required for the proposed ayacut of 600 acres with a duty of 50 acres per cubic foot per second. The remaining 800 feet at the head of the leading channel is proposed to be formed into a spring head by increasing the bed width gradually from 6 feet to 20 feet in the first 400 feet and maintaining the latter width for the rest 400 feet. The channel below the head sluice is proposed to be cleared to a bed width of 4 feet, slopes 1 to 1 and bed fall $2\frac{1}{8}$ feet per mile to discharge with 2 feet depth, the required supply of 12 cusecs.

The estimate also provides for excavating 10 field channels from the two distributaries already dug and for constructing 10 pipe sluices (one at the head of each field channel) and 9 cheap slab culverts where the field channels cross important cart-tracks.

It is recommended that the estimate be sanctioned as supplemental to that sanctioned in G.O., No. 940 I., dated 6th December 1901.

3. It is suggested that the ryots be asked to take up the contract for the works now estimated for as this will not only ensure the work being done at the time when it is really required by them but it will also facilitate the excavation of field channels. It is stated that the ryots have consented to give the land required for the field channels free of compensation ; accordingly only a nominal compensation of Rs. 25 has been allowed in the estimate for the lands required for these channels.

C. A. SMITH,
*Chief Engineer for Irrigation*

*22nd May* 1909.

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**Order—No. 236 I., dated 5th June 1909.**

The estimate, amounting to Rs. 4,890, for improvements to the Peddapasupula channel, Cuddapah district, is sanctioned as supplemental to the estimate sanctioned in G.O., No. 940 I., dated 6th December 1901.

2. This sanction is registered as No. 32 I. of 1909–1910.

3. The attention of the Superintending Engineer, III Circle, is drawn to paragraph 3 of the foregoing note by the Chief Engineer for Irrigation.

(True Extract.)

C. A. SMITH,
*Joint Secretary to Government, P.W.D.,*
*Irrigation Branch.*

To the Chief Engineer for Irrigation.
,, Superintending Engineer, III Circle, with plans and estimate.
,, Examiner, Public Works Accounts.
,, Revenue Department.

# Government of Madras.

PUBLIC WORKS DEPARTMENT.

IRRIGATION.
ACCOUNT.

| | | |
|---|---|---|
| *Regd.* | 1909. | *Enclosures* |
| *Recd.* | | *Spare copies* |

## G.O., No. 237 I., 7th June 1909.

### Siddapur Tank Project, Kurnool District

Directing the Superintending Engineer, III Circle, to submit, with the least possible delay, a revised estimate for the —, instructing him to restrict work on the project as much as possible pending orders thereon and ordering that the Government of India be informed accordingly.

GOVERNMENT OF MADRAS.

PUBLIC WORKS DEPARTMENT.

**Irrigation.**
**Account.**

Read—the following papers :—

I

**G.O., No. 109 I., dated 9th March 1909.**

Abstract.—The Inspection notes of the Chief Engineer for Irrigation on Siddapur project, Kurnool district, communicated to the Superintending Engineer, III Circle, for necessary action.

II

Telegram to the Superintending Engineer, III Circle, dated 18th March 1909.

Memorandum to the Superintending Engineer, III Circle, dated 19th March 1909, No. 1051.

Telegram from the Executive Engineer, Kurnool Division, dated 20th March 1909.

Telegram to the Superintending Engineer, III Circle, dated 20th March 1909.

Telegram from the Executive Engineer, dated 23rd March 1909.

III

*Letter*—from Mr. C. A. Smith, Joint Secretary to the Government of Madras, Public Works Department. Irrigation Branch.

*To*—the Secretary to the Government of India, Public Works Department.

*Dated*—the 31st March 1909.

*No.*—145 I.

I am directed to address you with reference to paragraph 1900 of the Public Works Department Code on the subject of the probable excess over the estimate sanctioned by the Government of India in their letter No. 1844 I., dated 4th November 1907, for the Siddapur Tank Project.

2. In December last it having become apparent after an inspection by the Chief Engineer for Irrigation of the work on the project that owing to anticipated excesses in various items the revision of the estimate was inevitable, the Superintending Engineer was asked to submit a very early report of the probable excess as it is beyond the powers of sanction by the Local Government. It is now reported that the sanctioned estimate will be exceeded by about Rs. 75,000 (for works) and that the revised estimate, which is under preparation, may be expected to reach the Chief Engineer for Irrigation by about the end of April.

3. It will be seen from the financial table appended, in which interest has been calculated at 3·412 per cent. on capital outlay, that even with the above increase in the estimated cost the project fulfils the condition of a productive work. Accordingly the execution of the work is proceeding pending receipt of the revised estimate.

ENCLOSURE.

## FORECAST OF FINANCIAL PROSPECTS.

SIDDAPUR TANK PROJECT.

PART IV.—Estimate of net Financial results of ten years after the probable date of completion of the work.

| Year. | Direct capital outlay during the year. | Direct capital outlay to end of year. | Simple interest at 3·412 per cent. on capital outlay to end of previous year *plus* half outlay during year. | Net revenue including enhanced land revenue, column 7 of part III. | Simple interest *less* net revenue. | Net revenue *less* simple interest. |
|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| | RS. | RS. | RS. | RS. | RS. | RS. |
| Preliminary expenditure on investigation .. .. | 5,000 | .. | .. | .. | .. | |
| 1907–1908 (actuals) .. .. | 5,015 | 10,015 | 256 | .. | 256 | .. |
| 1908–1909 (existing grant) .. | 33,998 | 44,013 | 922 | .. | 922 | .. |
| 1909–1910 (programme) .. | 1,23,000 | 1,67,013 | 3,600 | .. | 3,600 | .. |
| 1910–1911 .. .. .. | 1,50,000 | 3,17,013 | 8,257 | .. | 8,257 | .. |
| 1911–1912 .. .. .. | 1,50,000 | 4,67,013 | 13,375 | .. | 13,375 | .. |
| 1912–1913 .. .. .. | 1,09,475 | 5,76,488 | 17,802 | 9,129 | 8,673 | .. |
| 1913–1914 .. .. .. | .. | 5,76,488 | 19,670 | 18,098 | 1,572 | .. |
| 1914–1915 .. .. .. | .. | 5,76,488 | 19,670 | 27,069 | .. | 7,399 |
| 1915–1916 .. .. .. | .. | 5,76,488 | 19,670 | 27,069 | .. | 7,399 |
| 1916–1917 .. .. .. | .. | 5,76,488 | 19,670 | 27,069 | .. | 7,399 |
| 1917–1918 .. .. .. | .. | 5,76,488 | 19,670 | 27,069 | .. | 7,399 |
| 1918–1919 .. .. .. | .. | 5,76,488 | 19,670 | 27,069 | .. | 7,399 |
| 1919–1920 .. .. .. | .. | 5,76,488 | 19,670 | 27,069 | .. | 7,399 |
| 1920–1921 .. .. .. | .. | 5,76,488 | 19,670 | 27,069 | .. | 7,399 |
| 1921–1922 .. .. .. | .. | 5,76,488 | 19,670 | 27,069 | .. | 7,399 |
| 1922–1923 .. .. .. | .. | 5,76,488 | 19,670 | 27,069 | .. | 7,399 |
| Total .. | .. | .. | .. | .. | 36,655 | 66,591 |
| Indirect charges .. | .. | .. | .. | .. | 22,177 | .. |
| Total .. | .. | .. | .. | .. | 58,832 | 66,591 |
| Surplus revenue ten years after the date of completion .. | .. | .. | .. | .. | 7,759 | |

### IV

*Letter*—from P. R. ALLEN, Esq., M.I.C.E., Superintending Engineer, III Circle.
*To*—the Chief Engineer for Irrigation.
*Dated*—Bellary, the 30th March 1909.
*No.*—2056.

### V

**Memorandum No. 1307, dated 6th April 1909.**

### VI

*Telegram*—from P. R. ALLEN, Esq., M.I.C.E., Superintending Engineer, III Circle.
*To*—the Chief Engineer for Irrigation.
*Dated*—Madanapalle, the 6th May 1909.

### VII

*Letter*—from M.R.Ry. G. S. RAMA AIYAR Avargal, B.A., B.C.E., Executive Engineer, Kurnool division.
*To*—the Superintending Engineer, III Circle.
*Dated*—Kurnool, the 30th April 1909/1st May 1909.
*No.*—412/121 S.E.

## VIII

*Telegram*—from P. R. ALLEN, Esq., M.I.C.E., Superintending Engineer, III Circle.
*To*—the Chief Engineer for Irrigation.
*Dated*—Madanapalle, the 27th May 1909.

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**Order—No. 237 I., dated 7th June 1909.**

The Superintending Engineer, III Circle, will be requested to arrange for the submission of the revised estimate for the Siddapur project with the least possible delay. He should restrict work on the project as much as possible until final orders are passed on the revised estimate.

2. The following letter will be addressed to the Government of India.

[Here enter No. 238 I., dated 7th June 1909.]

(True Extract.)

C. A. SMITH,
*Joint Secretary to Govt., P.W.D.,*
*Irrigation Branch.*

To the Superintending Engineer, III Circle.
,, Chief Engineer for Irrigation.
,, Examiner, Public Works Accounts.
,, Revenue Department.

GOVERNMENT OF MADRAS.

PUBLIC WORKS DEPARTMENT.

No. 238 I.

**Irrigation.**
**Account.**

LETTER—from

MR. C. A. SMITH,

*Joint Secretary to the Government of Madras,*
*Public Works Department,*
*Irrigation Branch.*

To

THE SECRETARY TO THE GOVERNMENT OF INDIA,
PUBLIC WORKS DEPARTMENT.

SIR,

In continuation of my letter No. 145 I., dated 31st March 1909, I am directed to state that it is now reported that the sanctioned estimate for the Siddapur Tank project will be exceeded by Rs. 2,14,000 and that the revised estimate is under scrutiny in the Superintending Engineer's office. The project is thus practically certain to fail to fulfil the conditions of a productive public work, and the question of assuming financial responsibility will be dealt with by this Government as soon as the revised estimate is received and scrutinised. Meantime the Superintending Engineer has been directed to submit the revised estimate with the least possible delay and to restrict work on the project as much as possible pending orders thereon.

I have the honour to be,
Sir,
Your most obedient servant,

C. A. SMITH,
*Joint Secretary to Government, P.W.D.,*
*Irrigation Branch.*

OOTACAMUND,
*7th June 1909.*

# Government of Madras.

## PUBLIC WORKS DEPARTMENT.

IRRIGATION.
ACCOUNT.

| | | |
|---|---|---|
| *Recd.* | 1909. | *Enclosures* |
| *Regd.* | | *Spare copies* |

## G.O., No. 239 I., 9th June 1909.

**Stone Groynes between $20\frac{3}{4}$ and 21 B. Ms. of the Agunda Cauvery, Trichinopoly division**

An estimate of Rs. 4,400 for constructing — sanctioned.

GOVERNMENT OF MADRAS.

PUBLIC WORKS DEPARTMENT.

Irrigation.
Account.

Read—the following papers :—

I

*Letter*—from H. E. Clerk, Esq., Superintending Engineer, VI Circle.
*To*—the Chief Engineer for Irrigation.
*Dated*—Trichinopoly, the 10th March 1909.
*No.*—204 C.E.

I have the honour to forward herewith for your approval and sanction, an estimate amounting to Rs. 10,870, for constructing stone groynes between $20\frac{3}{4}$ and 21 B.Ms. of the Agunda Cauvery left bank. Owing to the formation of a very bad set, as can be seen from the sketch map enclosed, these permanent protective works are necessary to keep the bank (which is also main road from Trichinopoly to Salem) free from danger. As will be seen from the survey the set is just above the head of the Musiri Nattu voikal. It is therefore impossible to protect the bank by forming an extensive padugai. After personal inspection I consider the proposed groynes the best way of meeting the difficulty. The old groynes referred to in the report and also shown on the map are not only in bad order but also very low, say about a foot higher than the bed of the river. These will be removed and the stones available therefrom will be used for the new groynes.

The nose of the groynes will be 4 feet thick with slopes $\frac{1}{2}$ to 1 as shown on the sections and the interior of the groynes will be filled with sand.

The Brown Lows weed work on the red dotted line AB shown on the tracing is necessary for the reclamation of the river margin, will be separately sanctioned under repairs.

As permission has been given for the collection of material, so that the works may be completed before the next freshes, early sanction to the estimate is requested.

II

**No. 1099, dated 23rd March 1909.**

[His No. 204 C.E., dated 10th March 1909.]

Has the honour to invite his attention to the Inspection notes of the undersigned when Superintending Engineer, VI Circle, dated 10th December 1905, and to state that for the reasons therein stated the Chief Engineer for Irrigation doubts if the Superintending Engineer's proposals are the best.

2. It would appear from the report attached to the estimate that the old groynes have been serving the purpose for which they were intended, *i.e.*, of forming sand shoals below and between them which can be planted up with nanal, and their effect upon the bank as described in the report is not understood. It is also not understood how they can be interfering with the Coramboo channel as stated by the Collector.

3. The effect of the high groynes now proposed will be much more violent than the old ones and will very likely be to create a fresh scour lower down. The Chief Engineer for Irrigation is not at all in favour of long and high groynes like those proposed unless they are absolutely necessary and with the hard sub-soil which is believed to exist at this particular place, the Chief Engineer for Irrigation doubts if they are really necessary for the safety of the bank and would recommend a further trial of the low groynes.

4. It is requested that the Superintending Engineer will reconsider his proposals in the light of the above remarks, but if he still considers high groynes necessary it is suggested that they should in the first instance be made considerably shorter which will reduce the working of their action upon the river currents. The Chief Engineer for Irrigation quite recognizes that the present condition of affairs may be different to what it was when he inspected the place and if the Superintending Engineer is still of opinion that the groynes should be constructed as originally proposed the Chief Engineer for Irrigation will accept his recommendation.

5. It would appear from the report that the instructions contained in the inspection note of the undersigned were not given effect to and the Chief Engineer for Irrigation would be glad to know if this is the case.

C. A. Smith,
*Chief Engineer for Irrigation.*

To the Superintending Engineer, VI Circle.

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### III

*Letter*—from H. E. Clerk, Esq., Superintending Engineer, VI Circle.
*To*—the Chief Engineer for Irrigation.
*Dated*—Trichinopoly, the 31st March 1909.
*No.*—277 C.E.

With reference to your No. 1099, dated 23rd March 1909, I have the honour to inform you that the existing groynes in the 21st mile of Agunda Cauvery left flood bank have had the effect of forming shoals but not in the right places. I have not the survey to refer to but the accompanying sketch will show the existing state of affairs. The defect of the existing groynes is that although at an angle of about 60° with the bank they are at from 90° to 100° to the line of the current of the river, which comes as shown in blue arrows on the sketch. There is a tendency to scour immediately above the groyne and for shoals to form at the head of the Nattu voikal channel. I believe that by building the groynes at a more acute angle to the bank this trouble will be avoided.

I believe that this is the best way of treating the case.

I would however make the following modifications in the original proposals :—

(1) I would build three groynes instead of five as originally proposed as after reconsideration and discussion with the Executive Engineer I think three are enough.

(2) The groynes may be made low groynes but may be built solid. The cost of each groyne will be approximately what the high groyne with earthen core was.

With regard to paragraph 5 of your memorandum under reference the two extra low stone groynes ordered by you do not appear to have been made. Those existing were to some extent dismantled on account of the damage they were supposed to be doing.

Brown lows weeds were used with considerable success, a deposition of about 5 feet of sand having been formed on the bed.

As the season is far advanced and I consider it important to do work this year, I have authorized the Executive Engineer to go on with the work on the following lines :—

(1) The angle of the groynes to be the same as shown on the plans submitted to you.

(2) The groynes to be low groynes but built solid.
(3) Three groynes to be substituted for five as estimated.

I request that you will let me have early orders on this point. If you do not approve I request that you will telegraph instructions.

---

IV

**Memorandum No. 1310, dated 6th April 1909.**

With reference to letter No. 277 C.E., dated 31st March 1909 from the Superintending Engineer, VI Circle, the Chief Engineer for Irrigation has the honour to inform the Superintending Engineer, that the modifications suggested by him in connection with the construction of stone groynes between $20\frac{3}{4}$ and 21 B Ms. of the Agunda Cauvery are approved and the plans and estimate received with his letter No. 204 C.E., dated 10th March 1909, are herewith returned for revision and re-submission.

The Superintending Engineer's action in having permitted the Executive Engineer to put the work on hand in anticipation of sanction to the estimate is also approved.

(By order.)

T. W. S. SMYTH,
*Asst. Chief Engineer for Irrigation.*

To the Superintending Engineer, VI Circle.

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V

*Letter*—from H. E. CLERK, Esq., Superintending Engineer, VI Circle.
*To*—the Chief Engineer for Irrigation.
*Dated*—Trichinopoly, the 26th May 1909.
*No.*—437 C.E.

I have the honour to forward herewith for your approval and sanction of Government an estimate amounting to Rs. 4,400 for constructing stone groynes between $20\frac{3}{4}$ and 21 B. Ms. of the Agunda Cauvery prepared on the lines indicated in this office letter No. 277 C.E., dated 31st March 1909 and approved of by you in your Memorandum No. 1310, dated 6th April 1909.

As the Executive Engineer, Trichinopoly division, has already been asked to put the work in hand in anticipation of sanction to the estimate, I request that the estimate may be sanctioned at an early date.

---

ENCLOSURE.

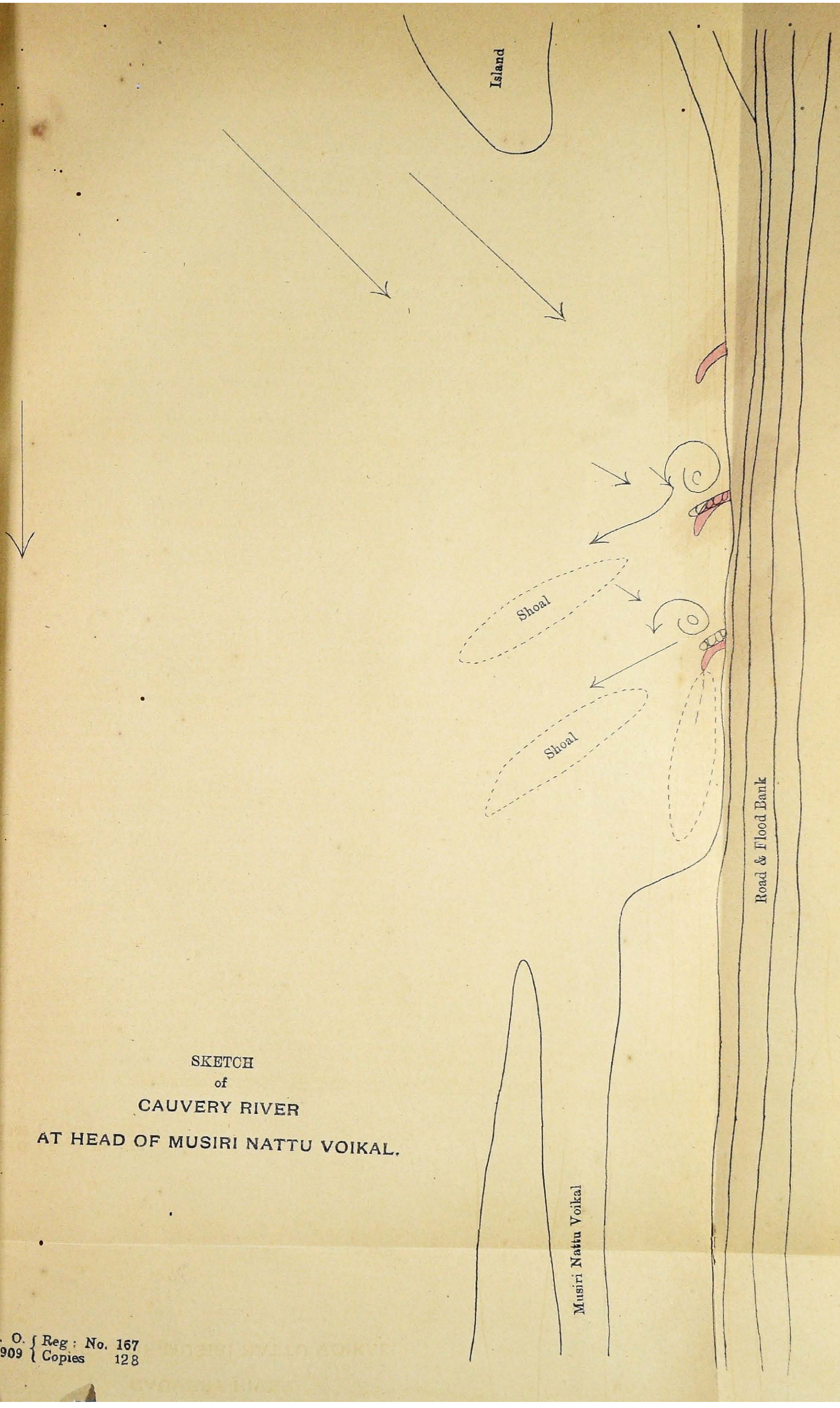
*Report to accompany estimate for permanent protective works at 21/O. B.M. of the Agunda Cauvery Left Margin.*

| | RS. |
|---|---|
| Amount of Estimate ... ... ... ... ... ... ... | 4,400 |

The left bank of the Agunda Cauvery which carries the trunk road to Madras *via* Salem is much eroded for about a furlong between B.Ms. 20/6 furlong and 21-0 and a reference to the survey will show that though the low existing groynes are placed at a suitable angle to the line of the bank, they make an obtuse angle with the main current line, diverting it against the bank, quite the opposite of the result desired, *i.e.*, eroding the bank more vigorously than the current itself could have done in the absence of the groynes.

The current impinges on the bank and the improperly situated groynes emerge at an angle to the bank crossing the Korambu channel of the Musiri Nattu voikal.

The Collector also complained that the groynes ever since they were constructed caused the formation of sand talus one from the nose of each of the groynes, extending across the Korambu channel of the Musiri Nattu voikal head, thus impeding the supply of the channel and suggested




SKETCH
of
CAUVERY RIVER
AT HEAD OF MUSIRI NATTU VOIKAL.

S. O. 1909 { Reg : No. 167
Copies 128

their removal and forming and revetting the bank at the erosion. This will only ensure the safety of the bank and the main point to get the current directly into the Musiri Nattu voikal leading channel cannot be gained for the curved and eroded portion of the high padugais will have exactly the same effect as the existing groynes.

The obliquity of the current is due to the existence of the Naduthittu island just above the Musiri Nattu voikal head, and hence works of a permanent nature have to be done to counteract its effect. Hence it is proposed in this estimate to remove the existing groynes and reform them in places shown on the survey.

The small quantity of stones available from the old dismantled groynes will be made use of in the new groynes and their cost will be shown as savings in the estimate.

The rates are fair and the estimate is recommended for sanction.

*6th May* 1909.

P. V. MANICKAM NAYAKAR,
*Executive Engineer, Trichinopoly Division.*

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## VI

### Note by the Chief Engineer for Irrigation.

The estimate amounting to Rs. 4,400 for constructing stone groynes between 20¾ and 21 B.Ms. of the Agunda Cauvery, received with the Superintending Engineer's letter No. 437 C.E., dated 26th May 1909, is recommended for sanction. In view of the urgency of the work, the Superintending Engineer has been permitted to put the work in hand in anticipation of sanction.

*4th June* 1909.

C. A. SMITH,
*Chief Engineer for Irrigation.*

**Order—No. 239 I., dated 9th June 1909.**

The Chief Engineer's recommendation is approved and the following estimate is sanctioned :—

Provincial.
Irrigation.
43. Minor Works and Navigation.
Class V. Agricultural works.
Original Works.
Trichinopoly Division.
Constructing stone groynes between 20¾ and 21 B.Ms. of the Agunda Cauvery.

| | RS. |
|---|---|
| Estimate ... ... ... ... ... ... ... ... ... | 4,400 |

2. This sanction is registered as No. 35 I. of 1909–1910.

(True Extract.)

C. A. SMITH,
*Joint Secy. to Govt., P.W.D.,*
*Irrigation Branch.*

To the Chief Engineer for Irrigation.
,, Superintending Engineer, VI Circle, with plans and estimates.
,, Examiner, Public Works Accounts.

# Government of Madras.

## PUBLIC WORKS DEPARTMENT.

IRRIGATION.
ACCOUNT.

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| *Recd.* | | | *Enclosures* |
| | 1909. | | |
| *Regd.* | | | *Spare copies* |

## G.O., No. 240 I., 9th June 1909.

### Vertical boiler

An estimate of Rs. 1,905 for purchasing a — for working the pulsometer in the Dowlaishwaram workshops, Gódávari Northern Division, sanctioned.

GOVERNMENT OF MADRAS.

PUBLIC WORKS DEPARTMENT.

**Irrigation.**
**Account.**

Read—the following papers :—

I

*Letter*—from Mr. C. W. Wood, Superintending Engineer, I Circle.
*To*—the Chief Engineer for Irrigation.
*Dated*—Vizagapatam, the 16th/19th December 1908.
*No.*—428 I.

I have the honour to forward herewith, for your approval and sanction, an estimate of Rs. 1,905 for purchasing a vertical boiler for working the pulsometer in the workshop at Dowlaishwaram.

The necessity for the boiler is explained in the report accompanying the estimate.

Enclosure.

*Report to accompany the estimate for purchasing a vertical boiler for working pulsometer.*

| | RS. |
|---|---|
| Amount of estimate ... ... ... ... ... ... ... | 1,905 |

The old boiler of the pulsometer at Dowlaishwaram having become unserviceable, it is proposed to replace it by one of the three vertical boilers recently received from England for "stock." This estimate therefore provides for a new boiler, and also for a trolly to make the boiler portable, which will be a decided advantage.

S. B. Murray,
*Executive Engineer, Gódávari Northern Division.*

II

**Memorandum No. 531, dated 16th February 1909.**

With reference to his letter No. 428 I., dated 16th December 1908, submitting an estimate for purchasing a vertical boiler for the pulsometer at the Dowlaishwaram workshops, the Superintending Engineer, I Circle, is requested to state the purpose for which the machine is used at the shops. This information is required to determine if the Superintending Engineer's classification of the estimate under the Irrigation head "42" instead of under the Provincial "45" is correct. The account head to which the pulsometer and the old boiler were charged should also be stated.

(By Order.)

T. W. S. Smyth,
*Assistant Chief Engineer for Irrigation.*

To the Superintending Engineer, I Circle.

### III

*Letter*—from Mr. C. W. WOOD, Superintending Engineer, I Circle.
*To*—the Chief Engineer for Irrigation.
*Dated*— Vizagapatam, the 21st March 1909.
*No.*—121 I.

With reference to your Memorandum No. 531, dated 16th February 1909, I have the honour to state that the classification of the estimate in question under "42." Tools and Plant is correct as the pulsometer is borne on the Irrigation Tools and Plant Return of the workshops. The cost of the old boiler was also charged to "42." Tools and Plant.

---

### IV

To the Superintending Engineer, I Circle, dated 16th April 1909, No. 1420.
From the „ I „ „ 28th May „ „ 485/W./G.N.

---

### V

**Note by the Chief Engineer for Irrigation.**

The estimate is recommended for sanction.

*8th June* 1909.

C. A. SMITH,
*Chief Engineer for Irrigation.*

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**Order—No. 240 I., dated 9th June 1909.**

The following estimate is sanctioned :—

Imperial.
Irrigation.
42. Minor Works (Working Expenses).
Gódávari Delta System.
Northern Division.
5. Tools and Plant.
2. Plant and Machinery.
Purchasing a vertical boiler for working the pulsometer in the workshop at Dowlaishwaram.

| | RS. |
|---|---|
| Estimate ... ... ... ... ... ... ... ... ... | 1,905 |

2. This sanction is registered as No. 42 I. of 1909–1910.

(True Extract.)

C. A. SMITH,
*Joint Secy. to Govt., P.W.D.,*
*Irrigation Branch.*

To the Chief Engineer for Irrigation.
„ Superintending Engineer, I Circle, with estimate.
„ Examiner, Public Works Accounts.

# Government of Madras.

## PUBLIC WORKS DEPARTMENT.

IRRIGATION.
ACCOUNT.

*Recd.* }
1909.
*Regd.* }

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## G.O., No. 241 I., 9th June 1909.

**Iron ferry ballacuts, Kurnool division**

Estimates, aggregating Rs. 1,700, for constructing two —, sanctioned.

GOVERNMENT OF MADRAS.

PUBLIC WORKS DEPARTMENT.

**Irrigation.**
**Account.**

READ—the following papers :—

I

*Letter*—from P. R. ALLEN, Esq., M.I.C.E., Superintending Engineer, III Circle.
*To*—the Chief Engineer for Irrigation.
*Dated*—Camp Horsleykonda, the 29th April 1909.
*No.*—2674.

I have the honour to forward for favour of sanction two estimates for constructing iron ballacuts, one amounting to Rs. 1,000 for a first-class ballacut and the other amounting to Rs. 700 for a second-class one, for the use of Kurnool division.

The report accompanying the estimate explains the necessity for the work.

Please also refer to my report on the abolition of navigation on the Kurnool-Cuddapah canal.

ENCLOSURE.

*Report to accompany estimate for constructing iron ballacuts for use in the Kurnool division.*

These are intended to replace two wooden ballacuts the wood-work of which has become rotten and which have therefore become unserviceable. The ballacuts are being made use of for taking soundings for the preparation of silt clearance estimates and for conducting velocity observations. It is intended to construct them in the Public Works Workshops at Dowlaishweram and bring them on railway train to Nandyal and thence taken to the canal, or they will be constructed in Madras and brought to Kristnapuram, the terminus of the canal.

G. S. RAMA AIYAR,
*Executive Engineer, Kurnool division.*

II

**Note by the Chief Engineer for Irrigation, dated 3rd June 1909.**

It is noted that the ballacuts are intended to be used for taking soundings and velocity observations and it is thought that for this purpose pinnaces of the pattern used in the Gódávari and Kistna delta will be found more convenient.

2. As however the ballacuts are not, it is believed, required entirely for the above purpose, the estimates are recommended for sanction.

C. A. SMITH,
*Chief Engineer for Irrigation.*

**Order—No. 241 I., dated 9th June 1909.**

The following estimates are sanctioned :—

Imperial.

Irrigation.

42. Major Works (Working Expenses).

Kurnool-Cuddapah Canal.

Kurnool Division.

5. Tools and Plant.

4. Navigation Plant.

| | RS. |
|---|---|
| (1) Constructing a first-class iron ferry ballacut— | |
| Estimate ... ... ... ... ... ... ... ... | 1,000 |
| (2) Constructing a second-class iron ferry ballacut— | |
| Estimate ... ... ... ... ... ... ... ... | 700 |

2. This sanction is registered as No. 34 I. of 1909–1910.

(True Extract.)

C. A. SMITH,
*Joint Secretary to Govt., P.W.D.,*
*Irrigation Branch.*

To the Chief Engineer for Irrigation.
,, Superintending Engineer, III Circle, with plans and estimates.
,, Examiner, Public Works Accounts.

# Government of Madras.

## PUBLIC WORKS DEPARTMENT.

IRRIGATION.

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## G.O., No. 242 I., 9th June 1909.

**Completion Reports on Irrigation Projects**

Letter from the Government of India issuing instructions regarding the preparation and submission of the —, communicated to the officers concerned for guidance.

## GOVERNMENT OF MADRAS.

## PUBLIC WORKS DEPARTMENT.

### Irrigation.

Read—the following paper :—

*Letter*—from Mr. L. M. Jacob, c.s.i., Secretary to the Government of India, Public Works Department (Civil Works—Irrigation).

*To*—the Joint Secretary to the Government of Madras, Public Works Department, Irrigation Branch.

*Dated*—Simla, the 11th May 1909.

*No.*—505—514-I.

I am directed to address you on the subject of the great delays which have occurred in the past, and which are still occurring, in the preparation and submission of the completion reports on irrigation projects. It is found that in some cases these reports have not reached the Government of India until after six or seven years from the date of closing the construction estimates.

2. A completion report, I am to point out, is described in Public Works Department Code II, 1919, IV and 1969 III, as a "report on the works executed at the time the construction estimate was closed"; it should therefore be submitted as soon as possible after the closing of the estimate, and there is nothing, in the rulings above referred to, to account for the long delays which have hitherto taken place. The Government of India, however, realise that there has been a tendency in some provinces to greatly elaborate these reports by entering into a history of the project from its first inception in very minute detail. Later, as often as not, the report has been subjected to revision, and by the time it is ready for submission to the Government of India it not infrequently bears the impress of an author who has had himself no connection with the scheme. The Government of India, I am to say, have no objection to such elaboration as may be thought desirable to make the publication more useful as a work of reference, or in the matter of the lessons it may have to teach for future projects of the same kind, as long as the labour involved by such work does not entail great delay. But if it becomes a question of an exhaustive report and much delay, or of a comparatively brief one submitted with promptitude, they are of opinion that the latter is preferable. I am to point out that a report of this character, the intentions of which are primarily that it should be a completion report, not a history, loses much of its value and usefulness if it does not follow promptly the closing of the estimate with which it deals, and that a timely report on the salient features of the scheme concerned is of more value than a more complete but long delayed review that has involved laborious research into old records and occupied the time and energies of several officers.

3. The Government of India see no reason why irrigation completion reports should not as a rule be submitted to them within six months of the closing of the project estimates, or certainly within twelve months in the case of exceptionally large schemes or for any special reasons. I am accordingly to request that [, with the permission of the Governor in Council / His Honour the Lieutenant-Governor,] the necessary steps may be taken in future to give effect to these instructions.

**Order—No. 242 I., dated 9th June 1909.**

Communicated to the officers concerned for information and guidance.

(True Extract.)

C. A. SMITH,
*Joint Secretary to Govt., P. W.D.,*
*Irrigation Branch.*

To the Chief Engineer for Irrigation.
,, Superintending Engineers of Circles.
,, Superintending Engineer on special duty.
,, Examiner, Public Works Accounts.

# Government of Madras.

## PUBLIC WORKS DEPARTMENT.

IRRIGATION.
ACCOUNT.

| | | |
|---|---|---|
| *Recd.* | 1909. | *Enclosures* |
| *Regd.* | | *Spare copies* |

## G.O., Nos. 243, 244 I., 10th June 1909.

**Quarters and sheds**

Forwarding a copy of the Proceedings sanctioning with remarks three estimates, amounting to Rs. 10,039, for the construction of — for the establishment, telephone and stores at the Vennar-Vettar Regulators, Cauvery Delta System.

GOVERNMENT OF MADRAS.

# PUBLIC WORKS DEPARTMENT.

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**Irrigation.**
**Account.**

READ—the following papers :—

I

*Letter*—from S. D. PEARS, Esq., Superintending Engineer, V Circle.
*To*—the Chief Engineer for Irrigation.
*Dated*—Chepauk, the 13th October 1908.
*No.*—389-E.I.

I have the honour to forward for sanction the accompanying estimate of rupees 8,500 with plans submitted by the Executive Engineer, Vennar Division, for constructing sheds for establishment at the Vennar-Vettar regulators, Cauvery Delta system. The necessity for the work is explained in the report attached to the estimate. I would add to what is there stated that at present half the establishment live in an adjoining village of Kallans with whom there is constant trouble, for many years past, on account of illicit fishing and other trespasses. So long as half the lascars belong to the trespassing fraternity, it is not only impossible to detect or punish offences and even to maintain ordinary discipline, but one Executive Engineer after another has been obliged to connive at the Superintendent's residing in Tanjore—7 miles distance—through sheer fear for his bodily safety. The first step towards remedying this undesirable state of things is to provide sufficient and suitable accommodation and to draft into it lascars who do not belong to the neighbouring village fraternity.

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II

**Memorandum No. 4091 dated 4th November 1908.**
[His No. 389 E.I., dated 13th October 1908.]

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Has the honour to return the estimate for revision and resubmission with reference to the following remarks.

2. The Superintending Engineer is requested to give the cost of each set of building separately.

3. The cost of the existing shed and shutters having to be written back from the Capital to the Revenue account of the system, the sum of Rs. 2,000 deducted from the total amount of the estimate on account of the cost of the old materials should be scoured out in order that the estimate might represent the true cost of the proposed buildings.

4. The old materials may be transferred to the proposed buildings at a valuation of what they would fetch in the open market and the rates worked out accordingly.

5. The Superintending Engineer is also requested to report the cost of the existing sheds.

6. The cost of the proposed buildings is considered high and the Superintending Engineer should consider the advisability of reducing it by building the compound walls in mud, plastered and also building the walls in mud except at the top, bottom and around the doors and windows.

(By Order.)

T. W. S. Symth,
*Asst. Chief Engineer for Irrigation.*

To the Superintending Engineer, V Circle.

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## III

*Letter*—from S. D. Pears, Esq., Superintending Engineer, V Circle.
*To*—the Chief Engineer for Irrigation.
*Dated*—Chepauk, the 22nd February 1909.
*No.*—75 E.I.

With reference to your Memorandum No. 4091, dated 4th November 1908, I have the honour to submit the marginally-noted estimates for sheds for establishment and for telephone and stores at the Vennar-Vettar regulators duly revised as therein desired.

| | RS. |
|---|---|
| 1. Lascars' sheds ... ... ... | 6,680 |
| 2. Telephone and store rooms ... | 550 |
| 3. Superintendent's quarters ... | 1,130 |

2. The costs of the existing Superintendent's quarters and eight lascars' sheds to be demolished and rebuilt are Rs. 468 and Rs. 1,060 respectively.

3. The works should be completed by October 1910.

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Enclosure.

*Report to accompany the estimate for constructing sheds for establihsment at Vennar-Vettar Regulators.*

| | RS. |
|---|---|
| Amount of estimate ... ... ... ... ... ... ... | 8,360 |

An establishment consisting of one Sub-Overseer and fourteen lascars is maintained at the Vennar-Vettar regulators to attend to regulation.

2. There exists at present one shed for the Sub-Overseer and eight smaller ones for lascars. All of them are built of brick in mud roofed with pan tiles supported on bamboo rafters, and are in a dilapidated condition, destruction by white ants being greatly in evidence.

3 Tools, etc., belonging to head works are kept in one of the sheds meant for lascars for want of accommodation.

4. The telephone office is located in one of the bath rooms of the Inspection bungalow, much to the inconvenience of officers and others during their halts.

5. About half of the establishment necessary live in adjacent villages and it is not found possible to muster them during nights on emergent occasions.

6. It is therefore proposed considering the importance of the head works to provide the whole of the establishment with quarters at the site.

7. But unfortunately a good site above M.F.L. is not available anywhere near and the Superintending Engineer decided during his inspection to extend the present line of sheds and to construct them in a substantial manner.

8. The existing foundation for the old sheds will be retained as they are of concrete in chunam and fresh extensions will be made towards the eastern side, where fresh concrete will be laid as per plan herewith.

9. The walls of the sheds will be of brick in mud except at the top, bottom and around the doors and windows and roof timber of teakwood. The width of the sheds though small, it is proposed to have trusses to enable the teakwood got from the old shutters at the head works which are to be renewed this year being utilised to the best advantage.

10. The compound walls for the sheds form comparatively a heavy item; and it is not found possible to omit them, without minimising the safety of the sheds, especially when their location amidst villages inhabited mostly by Kallars are considered.

11. The store and telephone sheds will be terraced and the rest roofed with flat and pan tiles.

12. The cost of these sheds will be considered comparatively high when compared with the sheds given to police peons; but when due allowance is made for extra foundation that are given to these huts for want of better site, the net cost of each hut will only be about Rs. 60 more, a sum quite insignificant when the substantial nature of the building now proposed is compared.

13. The old materials available from the existing sheds, viz., tiles about 20,000 and brick 25,000 in broken bits have been proposed to be utilised on the new work in the roofing and concrete items and the teakwood available from the shutters and top beams of the regulator to the extent of about 590 cubic feet exclusive of wastage in sawing and fitting up, have also been taken into account, labour alone having been provided for in the estimate.

14. The scantlings adopted are in accordance with the standards prescribed in Circular Memorandum No. 234 C., dated 9th January 1908.

U. S. RAMASWAMY AIYAR,
*Executive Engineer, Vennar Division.*

*12th January* 1909.

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## IV

### Note by the Chief Engineer for Irrigation, dated 3rd June 1909.

The Superintending Engineer, V Circle, submits for sanction the following three estimates for sheds for establishment, telephone and stores at the Vennar-Vettar Regulators, Cauvery Delta System :—

| | | RS. |
|---|---|---|
| (1) | Constructing sheds for 14 lascars, estimate ... ... | 6,680 |
| (2) | „ quarters for the Superintendent, estimate ... ... | 1,130 |
| (3) | „ sheds for telephone and stores, estimate ... ... | 550 |

The necessity for the sheds is clearly explained in the Superintending Engineer's letter first read above and the report accompanying the estimates. The amounts of the estimates have been raised in this office to Rs. 6,780, Rs. 1,140 and Rs. 560, respectively, owing to the substitution of teakwood bressummers for reinforced concrete slabs of 4″ and 5″ thickness allowed over the verandah pillars. The above alteration is found necessary as the thickness of the slabs provided for by the Superintending Engineer is insufficient and slabs of adequate thickness cost more than the bressummers now allowed.

As regards the quarters for the Superintendent, who is a sub-overseer, it may be noted that its estimated cost is within the permissible outlay, which works out to Rs. 1,432 under the new rules laid down by the Government of India in their Circular No. III Public Works, dated 19th September 1908 (*vide* G.O., No. 1276 W., dated 17th November 1908).

It is recommended that the estimates, as altered in this office, be sanctioned.

2. It is reported that the cost of the existing Superintendent's quarters and lascars' sheds is Rs. 468 and Rs. 1,060, respectively. No write-back of outlay in the case of the Superintendent's quarters is necessary, but as regards the sheds for the lascars, as the difference between the proposed expenditure and their original cost exceeds Rs. 1,000, the Examiner, Public Works Accounts, should be asked to write back the approximate original cost (Rs. 1,060) of the old sheds from the Capital to the Revenue Account of the Cauvery Delta System.

C. A. SMITH,
*Chief Engineer for Irrigation.*

**Order—No. 243 I., dated 10th June 1909.**

The following estimates are sanctioned :—

Imperial.
Irrigation.
Cauvery Delta System.
Vennar Division.

(1)

49.—Capital Expenditure not charged to Revenue.
Open Capital Account.
I. Works.
2. Main canals and Branches.
K. Buildings.
Unremunerative Work.

(*a*) Constructing sheds for 14 lascars at the Vennar-Vettar Regulators.

| | | RS. |
|---|---|---|
| Estimate ... | I. Works ... ... ... ... ... ... | 6,780 |
| | II. Establishment ... ... ... ... ... | 1,559 |
| | Total ... | 8,339 |

(2)

42. Major Works (Working Expenses).
I. Extensions and Improvements
K. Buildings.

| | | RS. |
|---|---|---|
| (*b*) | Constructing quarters for the Superintendent, estimate ... | 1,140 |
| (*c*) | ,, sheds for telephone and stores, estimate ... ... | 560 |

2. These sanctions are registered as Nos. 36 I, 37 I., and 38 I. of 1909–1910, respectively, the sanction accorded in the case of the estimate for lascars' sheds—item (*a*) above—expiring on the 31st March 1911.

3. The attention of the Examiner, Public Works Accounts, is drawn to paragraph 2 of the foregoing note by the Chief Engineer for Irrigation.

4. Ordered that a copy of these Proceedings be forwarded to the Government of India for information.

[Here enter No. 244 I., dated 10th June 1909.]

(True Extract.)

C. A. Smith,
*Joint Secy. to Govt., P.W.D.,*
*Irrigation Branch.*

To the Chief Engineer for Irrigation.
,, Superintending Engineer, V Circle, with plan and estimate.
,, Examiner, Public Works Accounts.

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**Endorsement—No. 244 I., dated 10th June 1909.**

Forwarded.

(By Order.)

C. A. Smith,
*Joint Secretary to Govt., P.W.D.,*
*Irrigation Branch.*

# Government of Madras.

## PUBLIC WORKS DEPARTMENT.

IRRIGATION.
ACCOUNT.

| | | |
|---|---|---|
| *Recd.* | 1909. | *Enclosures* |
| *Regd.* | | *Spare copies* |

## G.O., Nos. 245, 246 I., 10th June 1909.

**Completion Report**

Forwarding a copy of the Proceedings approving the — for the work, viz., "construction of river-wall and the re-forming of the flood bank at Bezwada Head works" recommended by the Chief Engineer for Irrigation.

GOVERNMENT OF MADRAS.

PUBLIC WORKS DEPARTMENT.

**Irrigation.**
**Account.**

Read—the following papers :—

I

**G.O., Nos. 834–35 I., dated 3rd August 1904.**

Abstract.—Approving the estimate, amounting to Rs. 4,33,759, and forwarding a copy of the Proceedings with plans and estimate to the Government of India for sanction.

**G.O., No. 977/A I., dated 2nd September 1904.**

Abstract.—Telegram to the Government of India stating that the approximate cost of old works at the Bezwada head works to be written back from the Capital to the Revenue Account is Rs. 39,886.

**G.O., No. 1109 I., dated 10th October 1904.**

Abstract.—Letter from the Government of India sanctioning the estimate, Rs. 4,33,759, for the construction of a river wall and the re-formation of the flood bank at Bezwada head works, communicated to officers concerned.

**G.O., No. 566 I., dated 14th June 1905.**

Abstract.—Reclassifying the sub-heads given in the order sanctioning the construction of a river wall and re-formation of the flood bank at Bezwada head works.

II

From the Superintending Engineer, II Circle, dated 22nd Jan. 1905, No. 442 I.
Tel. to the „ „ II „ „ 31st „ „ „ 316.
To the „ „ II „ „ 6th Feb. „ „ 394.

III

*Letter*—from Lieut.-Col. W. M. Ellis, R.E., Superintending Engineer, II Circle.
*To*—the Chief Engineer for Irrigation.
*Dated*—Bezwada, the 27th February 1907.
*No.*—675 I.

In reference to your Memorandum No. 394, dated 6th February 1905, I have the honour to request that you will be good enough to inform me if a statement showing the deviations made in the estimate sanctioned in G.O., No. 1109 I., dated 10th October 1904, is now required.

2. The works on the river wall have been completed and completion report which shows a saving of Rs. 53,923, has been approved by the Examiner, Public Works Accounts—*vide* Completion Report enclosed.

## Enclosures.

## *Completion Report of Original Works and Special Repairs.*

Name of work.—Constructing a river wall and reforming flood bank at Bezwada Head works.
Fund.—Imperial Irrigation.
Departmental head.—Capital Expenditure on Public Works not charged against Revenue.
Service head.—49. Irrigation—I. Works.
Main head of classification.—I. Head Works.
Sub-head of classification— { C. Works. / L. Earth-work.
Arm of the service.
Reference to last schedule docket submitted — *for the month of July* 1906.
Authority.—G.O., No. 566 I., dated 14th June 1905.

| Sub-heads of estimate. | As estimated. | | | As executed. | | | Differences*. | | | Reference to paragraphs explaining differences on page 5 *infra*. |
|---|---|---|---|---|---|---|---|---|---|---|
| | Quantity. | Rate. | Amount. | Quantity. | Rate. | Amount. | Quantity. | Rate. | Amount. | |
| *Constructing river wall below undersluices.* | | RS. A. P. | RS. | | RS. A. P. | RS. | | | RS. | |
| 1. Well curbs .. .. | 148 | 88 0 0 | 13,024 | 146 | 89 3 3 | 13,024 | 2·00 | .. | .. | |
| 2. Brick work in Portland cement with Bezwada brick. | 134·40 | 46 0 0 | 6,182 | 107·16 | 44 11 0 | 4,788 | 27·24 | .. | 1,394 | Items 2 to 5, please see paragraph 1 of explanation. |
| 3. Brick work in surki mortar with Bezwada bricks. | 103·50 | 23 12 0 | 2,458 | 289·65 | 21 11 5 | 6,290 | *—186·15* | .. | *—3,832* | |
| 4. Brick work in surki mortar with village bricks. | 32·75 | 26 0 0 | 852 | 16·80 | 42 5 5 | 711 | 15·95 | .. | 141 | |
| 5. Brick work in surki mortar with Dowleswaram bricks. | 115·20 | 44 8 0 | 5,126 | 40·32 | 55 6 11 | 2,235 | 74·88 | .. | 2,891 | |
| 6. Well sinking .. | 740 r. ft. | 5 0 0 | 3,700 | 686·25 | 4 8 4 | 3,104 | 53·75 | .. | 596 | |
| 7. Concrete in surki mortar with hard broken stone for wall. | 168·25 | 19 8 0 | 3,281 | 148·31 | 19 8 0 | 2,892 | 19·94 | .. | 389 | |
| 8. Concrete in surki mortar with hard broken stone for wells.* | 211·30 | 20 8 0 | 4,332 | 206·31 | 20 8 0 | 4,229 | 4·99 | .. | 103 | |
| 9. Concrete in surki mortar with ordinary broken stone for the wall between head and under sluices. | 837·70 | 18 0 0 | 15,079 | 837·70 | 18 0 0 | 15,079 | .. | .. | .. | |
| 10. Random rubble in surki mortar with jeddy stone. | 3,347·15 | 21 0 0 | 70,290 | 3,347·15 | 21 0 0 | 70,294 | .. | .. | — *4* | |
| 11. Dressed face work .. | 274·50 | 25 0 0 | 6,863 | 274·50 | 25 0 9 | 6,875 | .. | .. | — *12* | |
| 12. Pointing with Portland cement. | 274·50 | 2 8 0 | 686 | 274·50 | 2 0 3 | 553 | .. | .. | 133 | |
| 13. Sand filling over mass concrete. | 254·00 | 3 4 0 | 825 | 254·00 | 2 8 5 | 642 | .. | .. | 183 | |
| 14. Excavating foundations in ordinary hard and slushy soils. | Lump sum. | | 4,000 | .. | .. | 2,229 | .. | .. | 1,771 | |
| 15. Removing slush from foundations in water. | Lump sum. | | 800 | .. | .. | 990 | .. | .. | — *190* | |
| 16. Removing stones from foundations in water. | Lump sum. | | 2,000 | .. | .. | 1,291 | .. | .. | 709 | |
| 17. Demolishing masonry blocks and removing debries from slush and water. | Lump sum. | | 2,500 | .. | .. | 1,895 | .. | .. | 605 | |
| 18. Storing planks and piles including planks for wells. | Lump sum. | | 1,500 | .. | . | 1,014 | .. | .. | 486 | |
| 19. Baling water (by Engines, etc.). | Lump sum. | | 12,000 | .. | .. | 15,200 | .. | .. | — *3,200* | *Vide* paragraph 2 of explanation. |
| 20. Filling in scour hole below + 29·00. | Lump sum. | | 1,000 | .. | .. | 1,000 | .. | .. | .. | |
| 21. Filling in foundations and ramming. | Lump sum. | | 6,000 | .. | .. | 2,606 | .. | . | 3,394 | |
| 22. Testing foundation sub-soil. | Lump sum. | | 600 | .. | .. | 579 | .. | .. | 21 | |
| 23. Putting main ring bund with sand bags just after the breach. | Lump sum. | | 35,000 | .. | .. | 35,000 | .. | .. | .. | |
| 24. Other ring bunds .. | Lump sum. | | 2,000 | .. | .. | 1,853 | .. | .. | 147 | |

* Excesses to be entered in italics ; savings in ordinary type.

## *Completion Report of Original Works and Special Repairs*—cont.

| Sub-heads of estimate. | As estimated. Quantity. | Rate. | Amount. | As executed. Quantity. | Rate. | Amount. | Differences *. Quantity. | Rate. | Amount. | Reference to paragraphs explaining differences on page 5 *infra*. |
|---|---|---|---|---|---|---|---|---|---|---|
| *Constructing river wall below under sluices*—cont. | | RS. | RS. | | RS. | RS. | | RS | RS. | |
| 25. Sheds for materials and labour. | Lump sum. | | 5,000 | .. | .. | 4,281 | .. | .. | 719 | |
| 26. Supplying water for work in superstructure by fire engine. | Lump sum. | | 600 | .. | .. | 601 | .. | .. | — *1* | |
| 27. Building latrines and maintaining sanitation. | Lump sum. | | 600 | .. | .. | 1,218 | .. | .. | — *618* | *Vide* paragraph 3 of explanation. |
| 28. Clearing site and ramps. | Lump sum. | | 1,600 | .. | .. | 1,473 | .. | .. | 127 | |
| 29. Making cart routes and platform for materials. | Lump sum. | | 1,000 | .. | .. | 906 | .. | .. | 94 | |
| 30. Underpinning and stopping leakages using portland cement. | Lump sum. | | 1,500 | .. | .. | 372 | .. | .. | 1,128 | |
| 31. Total lumped sub-heads costing Rs. 500 and under, each. | Lump sum. | | 500 | .. | .. | 500 | .. | .. | .. | |
| 32. Petty supervision .. | .. | .. | 5,211 | .. | .. | 2,715 | .. | .. | 2,496 | |
| 33. Contingencies .. | .. | .. | 11,691 | .. | .. | 23,085 | .. | .. | —*11,394* | *Vide* paragraph 4 of explanation. |
| Total .. | | | 2,27,800 | | | 2,29,524 | | | — 1,724 | |
| *Constructing river wall in front of workshops.* | .. | .. | 34,200 | .. | .. | .. | .. | .. | 34,200 | |
| *Renewing ramps, etc., below under sluices.* | | | | | | | | | | |
| 1. Concrete in surki mortar with ordinary broken stone. | 99·00 | 18 0 0 | 1,782 | 98·65 | 12 15 3 | 1,278 | 0·35 | .. | 504 | |
| 2. Random rubble in surki mortar with jeddy stone. | 118·50 | 21 0 0 | 2,489 | 104·30 | 21 0 0 | 2,190 | 14·20 | .. | 299 | |
| 3. Dry stone packing with 1/3 old and 2/3 new stone. | 387·00 | 8 0 0 | 3,096 | 128·36 | 8 0 0 | 1,027 | 258·64 | .. | 2,069 | |
| 4. Filling in with sand .. | 2,245·00 | 1 0 0 | 2,245 | 2302·35 | 0 15 4 | 2,211 | 57·35 | .. | 34 | |
| 5. Cutstone work with old stone. | 50·00 | 32 0 0 | 1,600 | 25·00 | 32 0 0 | 806 | 24·80 | .. | 794 | |
| 6. Total of lumped sub-heads costing Rs. 500 and under. | Lump sum. | | 1,164 | .. | .. | 1,164 | .. | .. | .. | |
| 7. Petty supervision .. | Lump sum. | | 306 | .. | .. | 180 | .. | .. | 126 | |
| 8. Contingencies .. | Lump sum. | | 618 | .. | .. | .. | .. | .. | 618 | |
| Total .. | | | 13,300 | .. | .. | 8,856 | .. | .. | 4,444 | |
| *Demolishing and rebuilding workshop Superintendent's quarters.* | .. | .. | 5,000 | .. | .. | 152 | .. | .. | 4,848 | |
| *Unforeseen works* .. | .. | .. | 5,000 | .. | .. | 3,068 | .. | .. | 1,932 | |
| *Re-forming flood bank below Head Works.* | | | | | | | | | | |
| 1. Concrete in surki mortar with ordinary broken stone. | 57·50 | 17 8 0 | 1,006 | 30·47 | 17 8 0 | 533 | 27·03 | .. | 473 | |
| 2. Random rubble in surki mortar. | 75·20 | 20 0 0 | 1,504 | 87·73 | 20 0 0 | 1,755 | — *12·53* | .. | — *251* | |
| 3. Sattenapalli granite stone in surki mortar. | 13·80 | 46 8 0 | 642 | 8·54 | 42 15 0 | 367 | 5·26 | .. | 275 | |
| 4. Earthwork including cost of tramway and trucks. | 2,878·800 | 15 0 0 | 43,182 | 2,415·779 | 14 8 1 | 35,042 | 463·021 | .. | 8,140 | |
| 5. Revetment with dressed stone ⅔ new and ⅓ old. | 145·50 | 18 0 0 | 2,619 | 144·33 | 18 0 0 | 2,598 | 1·13 | .. | 21 | |
| 6. Total of lumped sub-heads costing Rs. 500 and under, each. | Lump sum. | | 1,821 | .. | .. | 1,727 | .. | .. | 94 | |
| 7. Petty supervision .. | Lump sum. | | 1,219 | .. | .. | 977 | .. | .. | 242 | |
| 8. Contingencies .. | Lump sum. | | 2,507 | .. | .. | .. | .. | .. | 2,507 | |
| Total .. | .. | .. | 54,500 | .. | .. | 42,999 | .. | .. | 11,501 | |

* Excesses are printed in italics ; savings in ordinary type.

*Completion Report of Original Works and Special Repairs*—cont.

| Sub-heads of estimate. | As estimated. Quantity. | As estimated. Rate. | As estimated. Amount. | As executed. Quantity. | As executed. Rate. | As executed. Amount. | Differences. Quantity. | Differences. Rate. | Differences. Amount. | Reference to paragraphs explaining differences on page 5 *infra*. |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | RS. | | | RS. | | | RS. | |
| *Filling in behind workshop wall to* + 71·00 | .. | .. | 3,500 | .. | .. | .. | .. | .. | 3,500 | |
| *Constructing revetment in front of workshops as per separate estimate.* | .. | .. | .. | .. | .. | 2,055 | .. | .. | — 2,055 | |
| *Providing Sattenapalle stone coping to the river wall below head sluice.* | .. | .. | .. | .. | .. | 2,856 | .. | .. | — 2,856 | |
| Total .. | .. | .. | 3,43,300 | .. | .. | 2,89,510 | .. | .. | 53,790 | |
| *Deduct* arrears due to labour. | .. | .. | .. | .. | .. | 133 | . | .. | 133 | |
| Total .. | .. | .. | 3,43,300 | .. | .. | 2,89,377 | .. | | 53,923 | |

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*Deviation from the estimate as sanctioned in G.O., No.* 1109 *I., dated* 10*th October* 1904, *as carried out in "constructing river wall and re-forming flood bank at Bezwada head works—" Estimate Rs.* 3,43,300.

Instead of the river wall in front of workshops sanctioned in the original estimate for Rs. 34,200, a revetment has been constructed in front of workshops at a cost of Rs. 2,055 against the estimate of Rs. 1,900 sanctioned in Chief Engineer's Memorandum No. 394, dated 6th February 1905.

2. The construction of the revetment referred to in paragraph 1 *supra* has rendered unnecessary another item sanctioned in the estimate "Filling in behind the workshop wall" Rs. 3,500.

3. Under the item "Demolishing and rebuilding Workshop Superintendent's quarters", Rs. 5,000: only demolishing has been done at a cost of Rs. 152. The quarters have not been rebuilt as the old Kistna Northern Division office has been provided for the Workshop Superintendent as quarters.

4. "Sattenapalli coping stone" has been provided to the river wall, although it was not sanctioned in the original estimate, as it was found necessary as ordered in Superintending Engineer's No. 550 K.N., dated 2nd December 1905.

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*Executive Engineers.*

| | From | To |
|---|---|---|
| A. G. Romilly, Esq. ... .. ... | October 1903. | 10th May 1905. |
| L. L. Wickham, Esq. ... ... ... | 11th May 1905. | 3rd January 1906. |
| M. Brown, Esq. ... ... ... ... | 3rd January 1906. | End. |

*Sub-Divisional Officers.*

| | | |
|---|---|---|
| M.R.Ry. L. A. Rangaswami Aiyar (Sub-Engineer) ... ... ... ... | December 1903. | 25th November 1904. |
| R. W. Formby, Esq. (Assistant Engineer) ... ... ... ... ... | 25th November 1904. | 5th December 1904. |
| H. L. Nicholson, Esq. (Assistant Engineer) ... ... ... ... ... | 5th December 1904. | 16th December 1904. |
| M.R.Ry. L. A. Rangaswami Aiyar (Sub-Engineer) ... ... ... ... | 16th December 1904. | 5th August 1905. |
| M.R.Ry. M. Ramakrishna Aiyar (Supervisor) ... .. ... ... ... | 5th August 1905. | 25th April 1906. |
| M.R.Ry. V. Gopalayya Garu (Assistant Engineer) ... ... ... ... | 25th April 1906. | 4th July 1906. |
| M.R.Ry. M. Ramakrishna Aiyar (Supervisor) ... ... ... ... ... | 4th July 1906. | End. |

*Section Officers.*

| | |
|---|---|
| M.R.Ry. S. Venugopal Nayudu (Temporary Upper Subordinate) ... ... | 17th October 1903 to 6th April 1905. |
| M.R.Ry. R. Panchapagesa Aiyar (Temporary Upper Subordinate) ... ... | 21st November 1903 to 2nd August 1905. |
| M.R.Ry. A. Kuppuswami Aiyar (Anicut Superintendent) ... ... ... | 3rd August 1905 to end. |

*Statement explaining the excesses on the sub-heads* :—

1. *Items* 2 *to* 5.—The total excess on these similar items taken together is 68·00 units in quantity, and in amount there is a saving of Rs. 594. The excess in quantity is due to extra height of some wells actually built to reach into the sandy sub-soil.

2. The excess in "Baling" is due to the fact that the estimate was only an approximate one and that there were increased springs in the course of the work which necessitated the extra expenditure.

3. "*Building latrines*".—The excess of Rs. 618 is due to the latrines having had to be erected and removed from place to place under the orders of the District Medical and Sanitary Officer in order to provide sanitary conditions to the very large number of coolies working on the spot and also to the fact that the night-soil had to be removed to a long distance.

4. The excess is due to the debit, mostly, of the charges for depreciation on the materials and machinery transferred from this work to other divisions and to stock, which was not anticipated while framing the original estimate.

*Details of the amounts debited to "Contingencies" under "River wall work."*

| | RS. | A. | P. |
|---|---|---|---|
| 1. Value of excess quantity of work done under dressed face work ... ... ... ... ... ... ... | 353 | 5 | 6 |
| 2. Do. on concrete in surki mortar with ordinary broken stone ... ... ... ... ... ... | 285 | 15 | 8 |
| 3. Do. random rubble in surki mortar with jeddy stones ... ... ... ... ... ... ... | 1,680 | 6 | 7 |
| 4. Do. pointing with portland cement ... ... | 317 | 11 | 3 |
| 5. Do. lumped sub-heads of Rs. 500 and under ... | 408 | 6 | 11 |
| 6. Do. sand filling over mass concrete ... ... | 398 | 7 | 4 |
| 7. Depreciation on value of materials transferred from the materials at site to Mopad division ... ... ... | 5,192 | 12 | 2 |
| 8. Do. do. Divi division ... ... | 335 | 0 | 0 |
| 9. Do. do. South Arcot division ... ... | 701 | 0 | 0 |
| 10. Do. do. Kistna Northern division ... | 1,495 | 14 | 6 |
| 11. Do. do. store stock, Kistna Central division ... ... ... | 7,068 | 0 | 0 |
| 12. Value of rubber hose worn out ... ... ... ... | 1,456 | 7 | 4 |
| 13. Difference between the value of one 15 H. P. Engine as per 7 F. accounts and that realized in auction ... ... | 2,561 | 14 | 10 |
| 14. Value of 1 centrifugal pump found useless ... ... | 622 | 0 | 0 |
| 15. Depreciation on value of materials transferred to Chingleput division ... ... ... ... ... ... | 207 | 2 | 5 |
| Total ... | 23,084 | 8 | 6 |

3rd *August* 1906.

M. BROWN,
*Executive Engineer, Kistna Central division.*

## IV

To the Superintending Engineer, II Circle, dated 14th March 1907, No. 1083.

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Reminder to the Superintending Engineer, | | II Circle, dated | | 19th September | 1907, | No. | 3665. |
| " | " | II | " | " | 18th December | " | " | 5101. |
| " | " | II | " | " | 12th February | 1908 | " | 706. |
| " | " | II | " | " | 21st August | " | " | 3091. |
| " | " | II | " | " | 23rd January | 1909 | " | 212. |

## V

*Letter*—from S. B. MURRAY, Esq., A.M.I.C.E., Superintending Engineer, II Circle.
*To*—the Chief Engineer for Irrigation.
*Dated*—Bezwada, the 14th May 1909.
*No.*—60 I.

With reference to your Memorandum No. 1083, dated 14th March 1907, I have the honour to forward a copy of the report and estimate of Rs. 1,900 for constructing a revetment in front of the Workshops and Bezwada lock.

The estimate was forwarded to you with this office No. 442 I., dated 22nd January 1905, and was approved in your Memorandum No. 394, dated 6th February 1905. The work was completed at a cost of Rs. 2,055.

This revetment was proposed in place of the following two sub-works included in the estimate of Rs. 3,43,300 for "constructing a river-wall" sanctioned in G.O., No. 1109 I., dated 10th October 1904.

| | | RS. |
|---|---|---|
| (i) Constructing a river-wall in front of Workshops | ... ... | 34,200 |
| (ii) Filling in behind the Workshop wall up to + 7,200 | ... ... | 3,500 |
| | Total ... | 37,700 |

The substitution of the revetment for the above two works resulted in a saving of Rs. 35,645 (34,200 + 3,500 − 2,055).

I regret the delay which has occurred in giving you this information.

## VI

**Note by the Chief Engineer for Irrigation, dated 3rd June 1909.**

In letter No. 1356-C.W.I., dated 19th September 1904 of the Government of India, printed with G.O., No. 1109 I., dated 10th October 1904, an estimate amounting to Rs. 3,43,300 (for "works") was sanctioned for constructing a river-wall and re-forming flood bank at Bezwada Head works, Kistna Delta system. The work having been completed, the Superintending Engineer, II Circle, submits a completion report showing a saving of Rs. 53,923, which is stated to be chiefly due to the—

(1) Substitution of "revetment" costing Rs. 2,055 for the "river-wall" in front of the Workshops which was estimated to cost Rs. 34,200.

(2) Omission of the item "filling in behind the Workshop wall (Rs. 3,500)" rendered unnecessary by the provision of revetment referred to above.

(3) Savings under minor items such as—

(*a*) excavating foundations and filling in,
(*b*) demolishing and rebuilding Workshop Superintendent's quarters,
(*c*) tram-line.

In regard to item (1) above, it may be noted that the revetment was substituted in place of river-wall as the former was considered, after the personal inspection of Mr. Garrett, to be sufficient and less expensive.

It is recommended that the completion report which has been verified by the Examiner be approved.

C. A. SMITH,
*Chief Engineer for Irrigation.*

**Order—No. 245 I., dated 10th June 1909.**

The completion report referred to is approved.

2. Ordered that a copy of these Proceedings be forwarded to the Government of India for information.

[Here enter No. 246 I., dated 10th June 1909.]

(True Extract.)

C. A. Smith,
*Joint Secretary to Govt., P.W.D.,*
*Irrigation Branch.*

To the Chief Engineer for Irrigation.
,, Superintending Engineer, II Circle
,, Examiner, Public Works Accounts.
,, Revenue Department.

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**Endorsement—No. 246 I., dated 10th June 1909.**

Forwarded.

(By Order.)

C. A. Smith,
*Joint Secretary to Govt., P.W.D.,*
*Irrigation Branch.*

# Government of Madras.

## PUBLIC WORKS DEPARTMENT.

IRRIGATION.
ACCOUNT.

*Recd.* } 1909. *Enclosures*

*Regd.* *Spare copies*

## G.O., No. 247 I., 11th June 1909.

**Allotments under the head "49. Irrigation Works"**

Ordered that a reply be despatched to the Government of India stating that no additional — are required for expenditure during the current year.

GOVERNMENT OF MADRAS.

PUBLIC WORKS DEPARTMENT.

**Irrigation.**
**Account.**

READ the following paper :—

*Letter*—from W. F. O'DONOGHUE, Esq., Deputy Secretary to the Government of India, Public Works Department (Account—Irrigation).

*To*—the Joint Secretary to the Government of Madras, Public Works Department Irrigation Branch.

*Dated*—Simla, the 25th May 1909.

*No.*—81-A.I.

With reference to the reductions found necessary in the amounts applied for under head "49. Irrigation Works" in the Schedule of demands for 1909–1910, I am directed to state that the Government of India are now in a position to sanction additional allotments under this head, and to enquire whether any more money can be usefully spent during the current year, and, if so, to what extent.

2. It is requested that an early reply may be furnished after the matter has received careful consideration.

**Order—No. 247 I., dated 11th June 1909.**

The following letter will be addressed to the Government of India.

[Here enter Letter No. 248 I., dated 11th June 1909.]

(True Extract.)

C. A. SMITH,
*Joint Secretary to Govt., P. W.D.,*
*Irrigation Branch.*

To the Chief Engineer for Irrigation (with a copy of letter).

GOVERNMENT OF MADRAS.

PUBLIC WORKS DEPARTMENT.

No. 248 I.

**Irrigation.**
**Account.**

LETTER—from

C. A. SMITH, Esq.,

*Joint Secretary to the Government of Madras,*
*Public Works Department,*
*Irrigation Branch,*

To THE SECRETARY TO THE GOVERNMENT OF INDIA,

PUBLIC WORKS DEPARTMENT.

SIR,

I am directed to acknowledge the receipt of Mr. O'Donoghue's letter No. 81–A.I., dated 25th May 1909, and to state that no additional allotments are required for expenditure during the current year under the head "49. Irrigation Works."

I have the honour to be,

Sir,

Your most obedient servant,

C. A. SMITH,
*Joint Secretary to Govt., P.W.D.,*
*Irrigation Branch.*

OOTACAMUND,
11*th June* 1909.

# Government of Madras.

## PUBLIC WORKS DEPARTMENT.

IRRIGATION.
ACCOUNT.

| | | | |
|---|---|---|---|
| *Recd.* | 1909. | *Enclosures* | |
| *Regd.* | | *Spare copies* | |

## G.O., Nos. 249, 250 I., 12th June 1909.

### Gauging operations

Forwarding for early sanction a copy of the Proceedings approving the consolidated estimate for — carried out in the various Public Works divisions of the Madras Presidency in 1908–1909 and those to be undertaken in 1909–1910.

GOVERNMENT OF MADRAS.

PUBLIC WORKS DEPARTMENT.

**Irrigation.**
**Account.**

READ—the following papers:—

I

**G.O., Nos. 136, 137 I., dated 22nd March 1907.**

ABSTRACT.—Certain particulars in connection with the irrigation projects likely to be executed in the Madras Presidency during the 20 years commencing from 1905–1906 required by the Inspector-General of Irrigation to enable him to determine the supplies of water available for the works ordered to be furnished to the Government of India.

**G.O., No. 307 I., dated 6th July 1907.**

ABSTRACT.—Communicating to all officers concerned the letter from the Government of India accepting with remarks the proposals of the Madras Government in connection with the gauging of rainfall and of rivers in the Madras Presidency and passing orders on the suggestion made by the Inspector-General of Irrigation on the subject.

**G.O., No. 249 I., dated 8th July 1908.**

ABSTRACT.—Letter from the Government of India on the subject of the arrangements made by this Government for the gauging of rainfall and rivers in the Madras Presidency and for recording observations communicated with remarks to the officers concerned.

**G.O., R. No. 348 I., dated 28th September 1908.**

ABSTRACT.—Recording correspondence between Superintending Engineer, IV Circle, and the Examiner, Public Works Accounts, intimating that a revised estimate was sanctioned for fixing gauges in the Cauvery and that the excess expenditure will be met from that estimate.

**G.O., No. 4 I., dated 8th January 1909.**

ABSTRACT.—Sanctioning estimates for the maintenance of a mechanic, watchers, etc., in connection with the Mopad project.

**G.O., No. 25 I., dated 23rd January 1909.**

ABSTRACT.—An index map of the Madras Presidency corrected up to 31st December 1908 showing the rain and river guage stations for projects likely to be executed during the 20 years commencing from 1908–1909 together with a tabular statement of the same and a note by the Chief Engineer for Irrigation thereon, ordered to be forwarded to the Government of India.

**G.O., No. 251, Revenue, dated 29th January 1909.**

ABSTRACT.—Recording letter from the Bombay Government regarding the methods adopted in that Presidency for taking and recording regular measurements of the flow of water in rivers.

## II

From the Superintending Engineer, III Circle, dated 18th Nov. 1907, No. 6415<br>
To the " " III " " 21st Jan. 1908 " 300.<br>
To Supg. Engineers, I, II, IV to VI Circles, " 21st " " " 301.<br>
From the Superintending Engineer, III Circle " 22nd " " " 540.<br>
" " " IV " " 28th Jan. " " 29-I./20-B.<br>
" " " IV " " 3rd Feb. " " 39-I./20-B.<br>
To the " " III " " 12th " " " 694.<br>
" " " IV " " 15th " " " 772.<br>
From the " " III " " 25th " " " 1490.<br>
" " " IV " " 31st Mar. " " 88-I./20-B.<br>
To all Superintending Engineers, dated 15th April 1908, No. 1582<br>
From the Superintending Engineer, V Circle, dated 16th April 1908, No. 154 E.I.<br>
" " " III " " 22nd " " " 3001.<br>
" " " III " " 22nd " " " 3002.<br>
" " " III " " 22nd " " " 3003.<br>
" " " II " " 25th " " " 33-I.<br>
" " " V " " 30th " " " 172 E.I.<br>
To the " " VI " " 11th May " " 1794.<br>
" " " I " " 11th " " " 1795.<br>
From the " " I " " 22nd " " " 216-I./Gj.<br>
" " " III " " 4th June " " 4050.<br>
To all Superintending Engineers, dated 30th June 1908, No. 2437.<br>
From the Examiner, Public Works Accounts, dated 26th Aug. 1908, No. 4279-B./BK.<br>
Telegram to the Superintending Engineer, VI Circle, dated 12th Sept. 1908.<br>
To the Examiner, Public Works Accounts, dated 14th Sept. 1908, No. 3401.<br>
From the Superintending Engr., IV Circle " 16th " " " 203-I./20-B.<br>
To the " IV " " 22nd " " " 207-O.<br>
From the " IV " " 26th Oct. " " 252-I./20-B.<br>
" " VI " " 3rd Nov. " " 622 C.E.<br>
" " VI " " 3rd " " " 623 C.E.<br>
" Government of India " 11th Dec. " " 2217-I.<br>
" Examiner, Public Works Accts. " 16th Mar. 1909 " 1309-B./B.K.<br>
" Government of India " 10th " " " 2117/1-I.<br>
" Examiner, Public Works Accts. " 16th " " " 1309 B./B.K.<br>
" Superintending Engr., V Circle " 3rd April " " 137 E.I.<br>
" " III " " 14th " " " 2325.<br>
" " II " " 19th " " " 32-I.<br>
" " I " " 23rd " " " 155-I.<br>
" Examiner, Public Works Accts. " 1st May " " 2070 B./B.K.<br>
To the Superintending Engr., I Circle " 6th " " " 82 Ref. C.<br>
From the " IV " " 18th " " " 112-I./443.<br>
" " IV " " 29th " " " 123-I./20-B.

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## III

**Note by the Chief Engineer for Irrigation, dated 5th June 1909.**

The Irrigation Commission having recommended to Government an expenditure of 44 crores of rupees in the twenty years commencing with 1905–1906, the Government of India with their letter No. 974 I., dated 13th July 1906 forwarded for the guidance of the Madras Government a note by the Inspector-General of Irrigation with a request that his suggestion might be carried into effect. The Inspector-General of Irrigation considered that projects involving such a large expenditure should be based on the most reliable data obtainable regarding the available water-supply. In order to collect such data, it was remarked by the Inspector-General that the observations in connection with river discharges and rain gauge readings should extend over a series of years, which may, at least, be ten years in advance of the preparation of projects. To this end, he made suggestions for the systematic maintenance of a record of gauging observations to be taken annually. Accordingly proposals were submitted to the Government of India accompanied by a tabular statement and map showing the location of all existing and proposed gauges and also the catchment areas of the several projects. These proposals have been approved by the Government of India, subject to such alterations as might be considered advisable

with reference to certain further suggestions made by the Inspector-General of Irrigation on the subject. Instructions were therefore issued to Superintending Engineers for the location of gauges and to commence observations in anticipation of sanction to the estimates for the work which the Superintending Engineers were asked to submit.

2. The accompanying consolidated estimate amounting to Rs. 27,062 has been prepared from the individual estimates received from the Superintending Engineers. Provision is made in this estimate for the erection of gauges and for the establishment required to maintain them up to 31st March 1910. It is recommended that the consolidated estimate be approved, and forwarded for the sanction of the Government of India, the local Government not being competent to deal with it.

3. It may be noted that the figures shown against the I Circle are tentative as the estimates received from the Superintending Engineer have been returned at his request for revision. But the original figures have been adopted for the purpose of the present consolidated estimate. In his estimate the Superintending Engineer had made provision for the gauging establishment to be maintained at Koradabadi station for a period of twenty years and this figure has been reduced to two years.

4. As the proposal to charge all expenditure on these operations, in the first instance, to the head "35. Construction of Protective Irrigation Works" made in letter No. 137 I., dated 22nd March 1907, has been approved by the Government of India, the outlay on gauging undertaken in connection with the investigation of Periyár-Pambiyar, which is still in its preliminary stage, should also be debited accordingly. But the expenditure * on these operations in 1909–1910 in connection with the re-investigation of the Cauvery and the Kistna Reservoir projects, which are sufficiently well advanced, is proposed to be debited against the head "43. Minor Works and Navigation," from which source the funds required to meet the cost of re-investigation have been provided.

* The outlay in 1908–1909 is included in the consolidated estimate.

C. A. SMITH,
*Chief Engineer for Irrigation.*

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**Order—No. 249 I., dated 12th June 1909.**

The recommendation of the Chief Engineer for Irrigation is approved.

2. The attention of the Superintending Engineer, I Circle, is drawn to paragraph 3 of the above note.

3. Ordered that a copy of these Proceedings be forwarded to the Government of India with a request that the estimate appended thereto may be sanctioned at an early date.

[Here enter No. 250 I., dated 12th June 1909.]

(True Extract.)

C. A. SMITH,
*Joint Secy. to Govt., P.W.D.,*
*Irrigation Branch.*

To the Chief Engineer for Irrigation.
Superintending Engineers of Circles.
,, the Examiner, Public Works Accounts.
,, the Superintending Engineer on Special duty.

**Endorsement—No. 250 I., dated 12th June 1909.**

Forwarded.

(By Order.)

C. A. SMITH,
*Joint Secy. to Govt., P. W.D.,*
*Irrigation Branch.*

## *Annexure to G.O., Nos. 249, 250 I., dated 12th June 1909.*

STATEMENT showing by circles the cost of erecting rain and river gauge stations and establishment for taking observations.

| Circle. | Projects | River gauge stations. | Rain gauge stations. | Estimate. Cost of erecting gauges. | Estimate. Expenses incurred for establishment up to 1907–1908. | Estimate. Cost of establishment for one year as submitted by Superintending Engineers. | Estimate. Cost of establishment for two years ending 1909–1910. | Remarks. |
|---|---|---|---|---|---|---|---|---|
| | | | | RS. | RS. | RS. | RS. | |
| I Circle .. | Baguva .. | On Baguva at Koradabadi .. | Koradabadi .. .. | 235 | .. | 85 | 170 | * Readings should be taken by Forest Department and the Superintending Engineer, I Circle, should arrange for this being done in communication with the District Forest Officer—*vide* Executive Engineer's letter printed with G.O., No. 249 I., dated 8th July 1908.<br>† It is stated in the estimate that the head lascar will be deputed to take readings.<br>‡ *Vide* remarks against Korasingi rain gauge. |
| | | | Korasingi * .. .. | 135 | .. | .. | .. | |
| | Godahallo .. | Godahallo aqueduct .. | .... | † 200 | .. | .. | .. | |
| | .... | .... | Bisamgiri .. .. | ‡ 135 | .. | .. | .. | |
| | | | Total .. | 705 | .. | 85 | 170 | |
| II Circle .. | Kistna .. | On Kistna above the confluence of Muniyeru. | .... | 650 | .. | 84 | 168 | The Superintending Engineer has made no provision for establishment required for recording the observations. The necessary provision has now been made by this office in the estimate. |
| | Pulikonda .. | .... | Donakonda .. .. | 170 | .. | 70 | 140 | |
| | Vengalapuram .. | .... | Chinnipad .. .. | 160 | .. | 70 | 140 | |
| | .... | .... | Magalleru .. .. | 53 | .. | 70 | 140 | |
| | Gundlakamma .. | On Gundlakamma river at dam site. | .... | 240 | .. | 64 | 128 | |
| | | | Total .. | 1,273 | .. | 358 | 716 | |
| III Circle .. | Pullampet .. | Rayavaram .. .. | Rayavaram .. .. | 260 | 120 | 80 | 160 | |
| | | On Mandavyanadi at Godikota. | Godikota .. .. | 268 | 49 | 80 | 160 | |
| | | | Soudapalli .. .. | 7 | .. | 56 | 112 | |
| | | | Kalakada .. ..<br>Kesapuram .. ..<br>Bodavandlapalli .. ..<br>Guvalacheruvu .. .. | Gauge in existence. | 336 | 224 | 448 | |
| | Chinnayyagaripalli. | On Pedda Eru at Chinnayyagaripalli. | Dam site .. .. | 138 | 70 | 80 | 160 | |
| | .... | .... | Isodam .. .. .. | Gauge in existence. | 84 | 56 | 112 | |
| | Itodu .. .. | On Vanda Manhalla at dam site. | Dam site .. .. | 267 | .. | 80 | 160 | |
| | Duraigallu .. | On Mandaleru at dam site .. | Do. .. .. | 268 | .. | 80 | 160 | |

Statement showing by circles the cost of erecting rain and river gauge stations and establishment for taking observations—*cont.*

| Circle. | Projects. | River gauge-stations. | Rain gauge-stations. | Estimate. Cost of erecting gauges. | Expenses incurred for establishment up to 1907–1908. | Cost of establishment for one year as submitted by Superintending Engineers. | Cost of establishment for two years ending 1909–1910. | Remarks. |
|---|---|---|---|---|---|---|---|---|
| | | | | RS. | RS. | RS. | RS. | |
| III Circle—*cont.* | Duraigallu—*cont.* | | Kalasamudram .. .. | 7 | .. | 56 | 112 | |
| | | | Obaladwara cheruvu .. | 8 | .. | 56 | 112 | |
| | | | Muddigubba Railway Station. | 7 | .. | 56 | 112 | |
| | Tungabhadra .. | On Tungabhadra dam site .. | Dam site .. .. .. | 1,095 | 150 | 144 | 288 | |
| | | On Hagiri at its mouth .. | .... | 313 | 98 | 108 | 216 | |
| | | On Pedda Hagiri at the site of Tungabhadra main channel crossing. | .... | 313 | 98 | 108 | 216 | |
| | | On Chinna Hagari at Vadahalli | .... | 313 | 98 | 108 | 216 | |
| | | On Pennar at Hoolikal .. | .... | 313 | 97 | 108 | 216 | |
| | | On Chitravati at Kodamurti .. | .... | 313 | 97 | 108 | 216 | |
| | | On Papaghni at Rajoopalem .. | .... | 695 | 135 | 90 | 180 | |
| | | On Cheyyeru at Brahmanapalli. | .... | 675 | 145 | .. | .. | Rs. 145 included to meet expenditure incurred during 1907–1908. Further observations proposed to be discontinued—*vide* Memorandum of the Chief Engineer for Irrigation, No. 3917, dated 8th October 1907. |
| | Upper Pennar .. | On Pennar at Porur .. | Perur .. .. .. | 460 | 56 | 108 | 216 | |
| | | On Cheyyeru at Balarayapalli. | .... | .. | 20 | .. | .. | Expenditure incurred during 1906–1907. Further observations have been stopped in accordance with the Memorandum of the Chief Engineer for Irrigation, No. 1084, dated 14th March 1907, and No. 2606, dated 5th July 1907. |
| | | Do. at Pulapathur .. | .... | .. | 20 | .. | .. | |
| | | On Cheyyeru at Nandalore Railway Station. | .... | .. | 20 | .. | .. | |
| | | On Pedda Eru at Kothala .. | .... | .. | 20 | .. | .. | |
| | | On Bahuda at Kalakada .. | .... | .. | 20 | .. | .. | |
| | | On Mandavya at Mathi .. | .... | .. | 20 | .. | .. | |
| | | On Gunjaneru at Vanginalla. | .... | .. | 20 | .. | .. | |
| | | Pedda Tippusamudran tank .. | .... | .. | 25 | .. | .. | |
| | | Kandakur tank .. .. | .... | .. | 25 | .. | .. | |
| | | Rangasamudram tank .. | .... | .. | 25 | .. | .. | |
| | | .... | Mulakalacheruvu .. .. | .. | 15 | .. | .. | |
| | | .... | Mallela .. .. .. | .. | 15 | .. | .. | |
| | | .... | Thamblapalli .. .. | .. | 15 | .. | .. | |
| | | .... | Bhorangi .. .. .. | .. | 42 | .. | .. | |

Statement showing by circles the cost of erecting rain and river gauge stations and establishment for taking observations—*cont.*

| Circle. | Projects. | River-gauge stations. | Rain-gauge stations. | Estimates. Cost for erecting gauges. | Expenses incurred for establishment up to 1907–1908. | Cost of establishment for one year as submitted by Superintending Engineers. | Cost of establishment for two years ending 1909–1910. | Remarks. |
|---|---|---|---|---|---|---|---|---|
| | | | | RS. | RS. | RS. | RS. | |
| III Circle—*cont.* | Chinna Tekur .. | Jungle stream at dam site .. | Dam site .. .. .. | 270 | .. | 73 | 73 | The Superintending Engineer having just submitted his estimate for these stations; observations will commence from the current year. |
| | Gudempad .. | On Chitayalayerrugudi vagu at dam site. | .... | 110 | .. | 59 | 59 | |
| | | .... | Dam site .. .. .. | 180 | .. | 44 | 44 | |
| | | .... | Pendakallu .. .. | 180 | .. | 44 | 44 | |
| | | .... | Lakkam Samudram .. | 180 | .. | 44 | 44 | |
| | Gazuladinna .. | On Hindri at dam site .. | .... | 120 | .. | 59 | 59 | |
| | | .... | Dam site .. .. .. | 180 | .. | 44 | 44 | |
| | | .... | Belupalla .. .. .. | 180 | .. | 44 | 44 | |
| | | .... | Deverkonda .. .. | 180 | .. | 44 | 44 | |
| | | .... | Aspari .. .. .. | 180 | .. | 44 | 44 | |
| | Krishnapuram .. | Kurnur vagu at dam site .. | Dam site .. .. .. | 270 | .. | 73 | 73 | |
| | Gundalakamma .. | On Thigaleru at Thokapalli .. | Thokapalli .. .. | 130 | .. | 68 | 68 | |
| | | .... | Dupad .. .. .. | 140 | .. | 50 | 50 | |
| | | .... | Dornala .. .. .. | 140 | .. | 50 | 50 | |
| | | | Total .. | 8,160 | 1,935 | 2,526 | 4,312 | |
| IV Circle .. | Gudumalai .. | On Swathanadi at dam site .. | Dam site .. .. .. | 246 | . | 84 | 168 | |
| | | Do. at Tidavur anicut. | .... | 34 | .. | 56 | 112 | |
| | Krishnagiri .. | On Ponniar at dam site .. | Dam site .. .. .. | 195 | .. | 105 | 210 | |
| | Cauvery .. | On Cauvery at Neringipet .. | .... | 2,400 | .. | 276 | 276 | This represents the estimate for 1908-1909. |
| | | On Cauvery and Bhavani bridge at Bhavani. | .... | .. | .. | 450 | 450 | The cost of gauging in the *current* year will be charged to the estimates for investigation of the Cauvery project called for from the Special Superintending Engineer. |
| | | | Total .. | 2,875 | .. | 971 | 1,216 | |
| V Circle .. | Vennar Division .. | Four small wooden boats for taking velocity observations in (4) four places. | .... | 700 | .. | .. | .. | This provision is made in supersession of that sanctioned in G.O., No. 477 I., dated 22nd December 1908. |
| | | | Total .. | 700 | .. | .. | .. | |
| VI Circle .. | Periyár. Pambyar. | On Meenar Pambyar .. | .... | .. | .. | 2,500 | 5,000 | The cost of the automatic gauge provided for by the Superintending Engineer in his estimate has been omitted as it is not yet fixed. |
| | | | Total .. | .. | .. | 2,500 | 5,000 | |

*Abstract.*

| Circles. | Cost for erecting gauges. | Expenses incurred for establishment up to 1907–1908. | Cost of establishment for one year as submitted by Superintending Engineers. | Cost of establishment for two years ending 1909–1910. | Total cost of gauges and establishment up to 31st March 1910, (columns 2 + 3 + 5). | Remarks. |
|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| | RS. | RS. | RS. | RS. | RS. | |
| I Circle .. .. | 705 | .. | 85 | 170 | .. | |
| II do. .. .. | 1,273 | .. | 358 | 716 | .. | |
| III do. .. .. | 8,160 | 1,935 | 2,526 | 4,312 | .. | |
| IV do. .. .. | 2,875 | .. | 971 | 1,216 | .. | |
| V do. .. .. | 700 | .. | .. | .. | .. | |
| VI do. .. .. | .. | .. | 2,500 | 5,000 | .. | |
| Total .. | 13,713 | 1,935 | 6,440 | 11,414 | .. | |
| Grand total .. | .. | .. | .. | .. | 27,062 | |

NOTE.—(*a*) In the III Circle under river gauge, Tungabhadra dam site, charges for establishment have been made for 12 months against 7 months provided in G.O., No. 249 I., dated 8th August 1908. For other six stations provision for establishment has been made for 9 months against 7 months in the Government Order quoted above.

(*b*) In Upper Penner at Perur river gauge establishment charges have been made for nine months against seven months as per Government Order referred to.

# Government of Madras.

**PUBLIC WORKS DEPARTMENT.**

IRRIGATION.

| | | |
|---|---|---|
| ***Recd.*** | 1909. | *Enclosures* |
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## G.O., No. 251 I., 15th June 1909.

**Erosion by the Coleroon River**

Informing, with remarks, Diwan Bahadur R. Ragunatha Rao that Government accept no responsibility for the — of his lands in Koviladi and Tiruchinampundi villages, Tanjore district.

GOVERNMENT OF MADRAS.

PUBLIC WORKS DEPARTMENT.

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**Irrigation.**

Read—the following papers:—

I

*Letter*—from Diwan Bahadur R. Ragunatha Rao, Kumbakónam.

*To*—the Joint Secretary to Government, Public Works Department (Irrigation Branch).

*Dated*—the 13th November 1908.

*No.*—536.

I beg to enclose copies of correspondence on the subject of loss I have suffered from the time the new anicut was built across the Cauvery and to state that I have received no redress from the subordinates of Government.

I am, therefore, compelled to place the matter respectfully before Government. Since the date of the last letter, dated the 13th October 1905, I have suffered further losses, all of them together amounting to many thousands of rupees.

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Enclosures.

(i)

*Letter*—from Diwan Bahadur R. Ragunatha Rao.

*To*—the Collector of Tanjore and J. C. Johnstone, Esq., Executive Engineer, Tanjore Division.

*Dated*—Koviladi, the 20th September 1895.

Forty years ago when the Mirasidars of Koviladi in the present taluk of Tanjore were permitted to occupy a strip * of land on the banks of the Coleroon, their application to occupy the land situated to the north of the aforesaid land was refused on the ground that they would not be able to prevent the encroachment of the river.

* Survey Nos. 2 to 11.

2. On the land taken up by the mirasidars, we raised topes of considerable sizes, of valuable and costly trees, sunk a substantial well and spent considerable amounts of money for recovering the land and preparing for the purpose of occupation as aforesaid.

3. Now we see that the conservancy of the river has been so ill-attended to that the stream has not only swallowed up the belt reserved by Government, as aforesaid, but has also encroached upon the so occupied area and washed away some of the valuable graft mango trees, which had been reared up at great cost by us. It is likely that this inroad of the river would continue, if not at once checked.

4. In these circumstances we beg that you will be pleased to order that proper measures be adopted to stop the inroad by planting durba grass, etc., and by erecting modashals and other protective works, thus restoring us our lands and creating the belt separating the occupied lands from the stream.

5. If this is not done soon, we will be under the necessity for taking up necessary steps at our cost, which would be a very heavy one; if we do so, we would occupy all the land thus recovered *inclusive* of the reserved strip, etc.

Soliciting immediate orders.

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(ii)

*Letter*—from Diwan Bahadur R. RAGUNATHA RAO, Kumbakónam.

*To*—Executive Engineer of Tanjore Division.

*Dated*—the 5th February 1897.

Much of the padugai lands of the Cauvery and the Coleroon in the villages of Koviladi, Tiruchinampundi and Pathirgudi belonging to me and my divided nephews were washed away by the floods of the last year. I have the honour to request that you will be so good as to plant nanal, etc., on their sites for their restoration as well as for the protection of the river banks.

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(iii)

*Letter*—from Diwan Bhadur R. RAGUNATHA RAO, Kumbakónam.

*To*—J. ANDREW, Esq., Acting Collector of Tanjore.

*Dated*—the 17th September 1897.

With very much regret I beg to bring to your notice that, owing to the continued neglect of Public Works Department, I have suffered serious losses in the villages of Koviladi and Tiruchinampundi, and that, unless you interfere, there is every reason to suppose that greater losses will be caused to me and serious injury will be done to vast tract of wet land for miles together, causing great loss of revenue to Government.

2. I beg to refer you to my letters noted in the margin, * copies of which I enclose for reference, from which you will see that I did my duty in warning the Public Works Department against the danger then imminent.

* 20th September 1895 to the Collector and Executive Engineer, Tanjore.

3. From the Grand Anicut, to a distance of about 7 miles eastward, the conservancy of the Coleroon has been so neglected, for the past many years, that many valuable trees to rear up which I had spent more than a thousand rupees, and the casuarina plantation valued many thousands have been washed away, and the Coleroon now flows within a very small distance from the banks.

4. The ryots of the villages had complained to the subordinates of the Public Works Department, and my divided nephews to Mr. Norfor, the District Engineer, on the 8th instant. He appears to admit that the conservancy of the river had been neglected and that emergent protection is necessary to the bank. He is, however, I am told, of opinion that the bank is proof against further encroachment of the river. Admitting, as I do, the importance of this assurance on his part, I am afraid that the bank may give way in some part or other, and it is therefore necessary to adopt all possible measures to remove all risk of such an occurrence.

5. I am told that deterioration in the conservancy of the river has arisen from the fact of all lands in this district to the north of the Coleroon bank having been placed within the jurisdiction of the officers of Public Works Department of the Trichinopoly district and that none of these officers has been inspecting these lands and doing the needful for a considerable time past.

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(iv)

*Letter*—from Diwan Bahadur R. RAGUNATHA RAO, Kumbakónam.

*To*—the Superintending Engineer, Public Works Department, Trichinopoly, and the Executive Engineer, Public Works Department, Trichinopoly division.

*Dated*—the 13th July 1901.

I own lands to the north of the High Road and to the south of the Coleroon, in the villages of Koviladi and Tiruchinampundi, 17th and 22nd mile, respectively, in the Tanjore district, just to the east of the Grand Anicut.

2. Some good portion of it, covered with graft mango trees, reared with great expense, has been washed away by the Coleroon, causing much loss to me. I complained of this to the officers of Public Works Department, Tanjore, and they tell me that the conservancy of the Coleroon is under your charge.

3. My agents have complained of the same to the Superintending Engineer and other officers of the Trichinopoly district and shown them the havoc committed by the erosion of the river.

4. I now beg to bring the same complaint to your notice and to request you that you will be pleased to do the needful for the restoration of the land and prevent any future erosion therein.

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(v)

*Letter*—from Diwan Bahadur R. RAGUNATHA RAO, Kumbakónam.

*To*—the Superintending Enginer, VI Circle, Trichinopoly.

*Dated*—the 31st December 1901.

I have the honour to draw your attention to my letter, dated the 13th July 1901, bringing to your notice the erosion caused by the river Coleroon to my lands on its margin between the 17th and 22nd mile to the east of the Grand Anicut and to state that nothing appears to have yet been done to remove the evil. I beg therefore to request that you will be good enough to do the meedful for the restoration of the lands washed away and to prevent further erosion at your earliest convenience.

2. Owing to the erosion just opposite to Attiani garden, 5 or 6 valuable graft mango trees and about 30 cocoanut trees have since been washed away and destroyed.

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(vi)

*Letter*—from Diwan Bahadur R. RAGUNATHA RAO, Kumbakónam.

*To*—the Superintending Engineer, VI Circle, Trichinopoly, and the Executive Engineer, Trichinopoly Division.

*Dated*—the 10th June 1902.

As it is reported to me that no steps have yet been taken to prevent the encroachment of the Coleroon on its right bank at the 22nd mile in the Tiruchinampundi village of the Tanjore taluk of the Tanjore district, as requested by me in my letters of 17th July 1901 and 31st December 1901, I beg to remind you of it, as a breach there would be a serious affair.

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(vii)

*Letter*—from Diwan Bahadur R. RAGUNATHA RAO, Kumbakónam.

*To*—the Superintending Engineer, VI Circle, Trichinopoly.

*Dated*—the 29th July 1902.

*No.*—62-A.

I beg respectfully to request you to be so kind as to inspect at once, before another flood comes on in the Cauvery, my garden to the east of the Grand Anicut, so that you may have a view of the heart-rending havoc done to my garden, which I have reared at an expense of many thousands of rupees. You will observe then how a number of graft mango trees yielding good produce have been uprooted, torn to pieces and washed away and down the river; similar has been the fate of other trees, viz., cocoanut, tamarind etc.

2. The Coleroon has so encroached upon the garden that there is a further risk of further damage, during the coming floods.

3. All this injury might have been prevented, if, in time, steps have been adopted to give a free vent to the water discharged through the Grand Anicut into the middle part of the Coleroon, instead of veering round the right bank of this river.

4. May I entreat you to inspect the locality and do the needful to prevent loss to me.

5. I beg also to bring to your notice that water at times rises so high as to cover over my garden and to flow over the bund which separates the Cauvery from the Coleroon, and which is also the only road from the Grand Anicut to the eastern part of this district.

(viii)

*Letter*—from Diwan Bahadur R. Ragunatha Rao, Kumbakónam.

*To*—the Executive Engineer, Public Works Department, Trichinopoly Division, Trichinopoly.

*Dated*—the 22nd November 1903.

*No.*—690.

I have the honor to remind you of my letters noted in the margin bringing to your notice the erosion caused by the river Coleroon to my lands on its margin between the 17th and 22nd miles to the east of the Grand Anicut and to state that nothing appears to have yet been done to remove the evil; some more valuable graft mango and cocoanut tress have been since washed away in this year's flood of July and November 1903 I beg therefore to request that you will be good enough to do the needful for the restoration of the lands washed away and to prevent further erosion, at your earliest convenience.

13th July 1901, 31st December 1901, 10th June 1902 and 29th July 1902.

(ix)

*Letter*—from Diwan Bahadur R. Ragunatha Rao.

*To*—the Executive Engineer, Tanjore Division.

*Dated*—Kovilādi, the 13th October 1905.

*No.*—566.

I see from notification in the *Fort St. George Gazette* that the conservancy of the Coleroon river has been entrusted to you. Since the execution of works at the Grand Anicut, owing to some deficiency in their constructions, the water in the Coleroon has washed away portions of my valuable garden in survey numbers 2, 3, 4 and 5 and lands in survey numbers from 13 to 19, a fact known to you and brought to the notice of Superintending Engineers of the Tanjore and Trichinopoly districts. Though something has been done by your Assistant M.R.Ry. N. Rajagopala Aiyangar, the injury is continuing and every year we suffer losses of thousands of rupees. In these circumstances, I beg that you will be pleased to adopt necessary measures to prevent further injury to my garden and to recover the land already washed away or buy them up for conservancy purposes.

II

**Endorsement No. 4727, dated 22nd December 1908.**

* In original to be returned.

Forwarded * to the Superintending Engineer, V Circle, for an early report.

(By order.)

T. W. S. Smyth.
*Asst. Chief Engineer for Irrigation.*

III

*Letter*—from S. D. Pears, Esq., Superintending Engineer, V Circle.

*To*—the Chief Engineer for Irrigation.

*Dated*—Chepauk, the 5th April 1909.

*No.*—141 E.I.

I have the honour to return the enclosures of your endorsement No. 4727, dated 22nd December 1908, together with a report and two tracings in original from the Sub-Divisional Officer, Conservancy Sub-division, bearing the Cauvery Division Executive Engineer's endorsement No. 2301, dated 29th March 1909.

2. I submit that Government is in no degree responsible for the training of the Coleroon except in so far as they find it necessary for the single purpose of defending the embankments, and unless it can be proved by a landowner that damage is directly due to some specific act of Government, any erosion must be held to be the act of God.

2. Some good portion of it, covered with graft mango trees, reared with great expense, has been washed away by the Coleroon, causing much loss to me. I complained of this to the officers of Public Works Department, Tanjore, and they tell me that the conservancy of the Coleroon is under your charge.

3. My agents have complained of the same to the Superintending Engineer and other officers of the Trichinopoly district and shown them the havoc committed by the erosion of the river.

4. I now beg to bring the same complaint to your notice and to request you that you will be pleased to do the needful for the restoration of the land and prevent any future erosion therein.

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(v)

*Letter*—from Diwan Bahadur R. RAGUNATHA RAO, Kumbakónam.

*To*—the Superintending Enginer, VI Circle, Trichinopoly.

*Dated*—the 31st December 1901.

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2. Owing to the erosion just opposite to Attiani garden, 5 or 6 valuable graft mango trees and about 30 cocoanut trees have since been washed away and destroyed.

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*Letter*—from Diwan Bahadur R. RAGUNATHA RAO, Kumbakónam.

*To*—the Superintending Engineer, VI Circle, Trichinopoly, and the Executive Engineer, Trichinopoly Division.

*Dated*—the 10th June 1902.

As it is reported to me that no steps have yet been taken to prevent the encroachment of the Coleroon on its right bank at the 22nd mile in the Tiruchinampundi village of the Tanjore taluk of the Tanjore district, as requested by me in my letters of 17th July 1901 and 31st December 1901, I beg to remind you of it, as a breach there would be a serious affair.

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2. The Coleroon has so encroached upon the garden that there is a further risk of further damage, during the coming floods.

3. All this injury might have been prevented, if, in time, steps have been adopted to give a free vent to the water discharged through the Grand Anicut into the middle part of the Coleroon, instead of veering round the right bank of this river.

4. May I entreat you to inspect the locality and do the needful to prevent loss to me.

5. I beg also to bring to your notice that water at times rises so high as to cover over my garden and to flow over the bund which separates the Cauvery from the Coleroon, and which is also the only road from the Grand Anicut to the eastern part of this district.

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*Dated*—the 22nd November 1903.

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13th July 1901, 31st December 1901, 10th June 1902 and 29th July 1902.

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(ix)

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*To*—the Executive Engineer, Tanjore Division.

*Dated*—Koviladi, the 13th October 1905.

*No.*—566.

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II

**Endorsement No. 4727, dated 22nd December 1908.**

Forwarded * to the Superintending Engineer, V Circle, for an early report.

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(By order.)

T. W. S. SMYTH,
*Asst. Chief Engineer for Irrigation.*

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III

*Letter*—from S. D. PEARS, Esq., Superintending Engineer, V Circle.

*To*—the Chief Engineer for Irrigation.

*Dated*—Chepauk, the 5th April 1909.

*No.*—141 E.I.

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ENCLOSURE.

*Letter*—from M.R.Ry. N. RAJAGOPALA AIYANGAR Avargal, Sub-Divisional Officer, Conservancy Sub-division, Tanjore.

*To*—the Executive Engineer, Cauvery Division.

*Dated*—Camp Tanjore, the 19th March 1909.

*No.*—349.

[Ref. D.O. No. 96, dated 5th January 1909.]

I have the honor to submit herewith 2 survey sheets, sheet No. 1 showing the position of the survey field Nos. 2 to 19 referred to in Diwan Bahadur R. Ragunatha Rao's No. 566, and sheet No. 2 showing the erosions and protective works carried out in Tiruchinampundi village.

2. In sheet No. 1 the present right margin of the Coleroon river is shown in red ink line.

3. As regards the erosion of the river along the right margin in survey Nos. 2 to 11, I beg to state that the width of the river between the alignment lines is fixed at 2,500 feet. With this width, the right alignment line passes along the road to the south of the survey Nos. 2 and 3, leaving only a small portion at the west end and east end respectively in survey Nos. 2 and 3. To have some padugai between the alignment line and the bank, the Cauvery left bank which forms also the right bank of the Coleroon here, has to be diverted along the line A.B. shown in red dotted line in the survey. Hence the erosion in survey Nos. 2 and 3 from which a lot of trees had been washed away is not to be attended to in the interest of the conservancy of the river. Regarding survey Nos. 4 to 12 the margin of the river is already on the river side of the patta lands.

4. As regards the erosion complained of in survey Nos. 14 to 19, the floods from 1896 to 1903 had mostly washed away the lands causing a serious erosion with deep scour holes close to the bank. To protect the bank from imminent danger a series of stone groynes were constructed at the erosion at a very heavy cost in 1904 and by continuing nanal and neernochi plantations the erosion has been regained and there is nanal padugai here to a width of about 500 feet. The planting work will be gradually brought up to the alignment line.

5 As regards the erosion in Tiruchinampundi village (*vide* sheet No. 2), *i.e.*, from mile 21 to 22/6, the width of the river from 21 to 21/7 being narrow, the bank was diverted during the last season. All along from 21 to 22/6, a series of earth groynes, pile groynes and stone groynes were constructed from 1904 onwards and the planting works pushed on wherever possible to save the bank from breaching and to bring up the plantations to the alignment lines.

6. I believe Diwan Bahadur Ragunatha Rao is informed by his cousin Mr. R. Vasudeva Rao of these works carried out all along the margin in Tiruchinampundi village as also along the erosion in survey Nos. 14 to 19 in Koviladi village called also Sukkambar set. These protective works in survey Nos. 14 to 19 and in Tiruchinampundi village are being carried out in the patta lands of Diwan Bahadur R. Ragunatha Rao and others, and Diwan Bahadur R. Ragunatha Rao has given his consent to plant nanal in his patta lands with of course the condition that he has to get back the lands when they are regained and are not required by the department. But if he wants the department to buy the lands now, I shall submit land plans and schedules for the same.

7. All conservancy works along the Coleroon are being carried out with a view to protect the banks from breaching and bringing up the plantations to the alignment lines; protection of private land when it is not in the interest of the conservancy of the river is not contemplated. The protection of the survey Nos. 2 and 3 in Koviladi village just below the infall of the Grand Anicut surplus falls under the latter category and so has not been attended to.

8. By nature, the low stream in a big river as the Coleroon takes a widening and zigzag course, the current which strikes (say) the right margin being reflected to the left at some distance below and then turned back to the right and so on. During floods the strong current with high velocity follows the direction of the low current and causes scour holes and erosions at the margin against which it strikes. It is impossible to make the low stream and the strong current during floods run along the centre of the river and all our conservancy works are therefore confined to keep the margins along the alignment lines as far as possible. Nothing is contemplated to be done for the protection of the private lands which fall between the alignment lines as in the case of survey Nos. 2 and 3 at Koviladi.

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**Order—No. 251 I., dated 15th June 1909.**

The Government agree with the views expressed by the Superintending Engineer in paragraph 2 of his letter No. 141 E.I., dated 5th April 1909.

2. With reference to his petition No. 536, dated 13th November 1908, Diwan Bahadur R. Ragunatha Rao is informed that Government do not undertake protective works in the interests of private lands, unless they are required in the interests of the conservancy of the river such as the protection of the flood banks. Where protective works are not required, for instance at survey Nos. 2 and 3 in Koviladi village, they cannot be undertaken by Government; but it is understood that they have been undertaken at survey Nos. 14 to 19 in Koviladi village and 2 to 8 in Tiruchinampundi village as they were required in the public interests.

3. Government accept no responsibility for damages caused by floods unless they are directly due to any action of theirs which as regards the erosions complained of does not appear to be the case.

(True Extract.)

C. A. SMITH,
*Joint Secretary to Govt., P.W.D.,*
*Irrigation Branch.*

To the Chief Engineer for Irrigation.
,, the Superintending Engineer, V Circle.
,, the Revenue Department.
,, Diwan Bahadur R. Ragunatha Rao (paragraphs 2 and 3 only) in manuscript.

# Government of Madras.

## PUBLIC WORKS DEPARTMENT.

IRRIGATION.

| | | |
|---|---|---|
| *Recd.* | 1909. | *Enclosures* |
| *Regd.* | | *Spare copies* |

## G.O., No. 252 I., 15th June 1909.

**Dorigallu Project, Cuddapah District**

Approving the recommendation of the Chief Engineer for Irrigation to finally abandon the —.

GOVERNMENT OF MADRAS.

PUBLIC WORKS DEPARTMENT.

## Irrigation.

Read—the following papers:—

I

### G.O., No. 2153 W., dated 12th August 1901.

Abstract.—Ordered that the report of the Superintending Engineer on special duty be laid before the Government of India and sanction requested to the estimate of Rs. 68,340 for the establishment required for preliminary investigations of Famine Protective works.

II

### G.O., No. 904 W., dated 19th August 1907.

Abstract.—The entertainment for a period of four months during 1907–1908, of certain surveyors and survey lascars to carry out the investigations necessary for the preparation of plans and estimates for the Dorigallu project, Cuddapah district, sanctioned.

III

### Memorandum No. III/17-C.D., dated 23rd April 1898.

The undersigned is informed that there is what may probably be found a good site for a reservoir (and below it a sufficiently large irrigable area) on the Muddaleru river in the Kadiri taluk of the Cuddapah district, a few miles north or north-east of the Moodigooba Railway station. The Superintending Engineer is requested to supply such information as he has about this and if the site has not been examined to call for a report on it.

2. There is no information in this office regarding the projects except the Yellugal project dealt with in G.O., No. 637 I., dated 22nd July 1892, which have been enquired into in the Cuddapah district and the Superintending Engineer would oblige by supplying a list of those which have been abandoned after enquiry or are still not enquired into.

W. Hughes,
*Chief Engineer for Irrigation.*

To the Superintending Engineer, III Circle.

IV

*Letter*—from J. C. Larminie, Esq., m.i.c.e., Superintending Engineer, III Circle.
*To*—the Chief Engineer for Irrigation.
*Dated*—Bellary, the 9th May 1898.
*No.*—467 I.

With reference to your Memorandum No. III/17 C.D., dated 23rd April 1898, I have the honour to state that the reservoir referred to in paragraph 1 of your memorandum under disposal is in connection with the Dorigallu project in Kadiri taluk.

2. I am submitting a file of papers containing surveys, sections, etc., a report on the project prepared by No. 6, Tank Restoration Scheme party, working in the Cuddapah division under Conductor Ulyett.

3. A copy of letter No. C. 282, dated 11th May 1897, from the Executive Engineer, Cuddapah Division, together with a copy of this office final orders on the subject, No. 5993, dated 12th February 1898, is forwarded for your information.

4. Paragraph 2 of your memorandum quoted above is being referred to Executive Engineer, Cuddapah; his reply will be communicated.

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### Enclosures.

*Letter*—from S. B. Murray, Esq., Executive Engineer, Cuddapah Division.
*To*—the Superintending Engineer, III Circle, Bellary.
*Dated*—the 11th May 1897.
*No.*—C. 282.

I have the honour to forward herewith a file of papers containing surveys, sections, etc., and a report on the Dorigallu tank project, which have been prepared by the Tank Restoration Scheme party working under Conductor Ulyett.

This project is one of the proposed works (No. 34, I think) for the Kadiri taluk in the famine relief programme. The proposal has been thoroughly investigated by Conductor Ulyett and, after discussing the question with him and looking into his report, I have come to the conclusion that it would not be advisable to form a tank as proposed. There seem to me to be several reasons against such a work being carried out. In the first place the district all round Dorigallu is very poor and thinly populated. Dorigallu itself is a small village, in which there are said to be no men of means and there is not a single large village in the neighbourhood.

To make the project pay, at least 2,000 acres of dry land would have to be taken up and converted into wet. This means the expenditure of a large amount of capital, far more than the locality can be reckoned on to produce. Then comes the question of the disposal of the surplus water. As I shall point out directly, it will be necessary to hold up water about 50 feet and the question of getting rid of the discharge from an area of over 500 square miles, with a drop of 50 feet, is not one to be lightly entered on.

The next thing to consider is the duty of the tank and what it would be capable of doing. From contours taken there seems to be a practically unlimited area of land, which would be commanded if a tank were formed at the site selected, and with a free catchment area of over 100 square miles and a total one of 532 square miles, there can be no question of want of water —granted that as much water and land as is required are available, the next thing is to see how best the water can be utilised. Contours have been taken for a tank at different levels up to 50 feet above bed level, and you will see from the report that the capacities are very small. At the 50 feet contour, the capacity is 433 mills. cubic feet according to Conductor Ulyett, but I make it 395 mills. cubic feet. This quantity is enough for about 2,000 acres (at 216,000 cubic feet per acre), but as is shown on page 5 of the report the river is capable of directly irrigating this area for 8 months, so unless irrigation is to be carried on all the year round, the storage of this quantity of water does not seem necessary. Assuming, however, that it is considered necessary, the question of cost may now be looked into. From quantities I took out roughly, I estimated that the bund would cost for earthwork and revetment Rs. 1,00,000, sluices and weirs Rs. 25,000, distributary channels and Dorigallu tank Rs. 15,000,—say, Rs. 1,40,000 altogether.

It may be as well to mention here that the bed of the river is mostly sheet rock, which is not a good thing to put an earthen bund with a head of water of 50 feet against it on.

From what I have said above I think it will be apparent that I am not in favour of the formation of a tank near Dorigallu, but provided the ryots are ready and willing to convert their dry land into wet, I see no reason why direct irrigation should not be carried on from the Muddaleru river. It is shown in the report that sufficient water for the irrigation of 2,000 acres can be depended on to come down the river for 8 months in the year and it would be a very easy matter to intercept this water by means of a small anicut and distribute it to both banks. I would also considerably enlarge the capacity of Dorigallu tank (water level could easily be raised to + 300, the present F.T.L. being + 288) and fill it with flood water.

I have not estimated what this alternative scheme would cost, but I do not see how it could amount to one-fifth of the cost of the tank and it is not open to any of the objections I have raised against the former inasmuch as it does not interfere with the surplus, does not hold up water which is not required and is far cheaper—granted that the ryots will convert their land and pay wet rates it should be a very paying little project.

I am sending you on all the papers and shall be glad to have your opinion at an early date as to what ought to be done in the matter, as the Tank Restoration Scheme party are still in the Kadiri taluk and can easily do whatever additional field work is necessary.

I consider that the way Conductor Ulyett has sent up his report is very creditable to him.

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*Memorandum*—from J. C. LARMINIE, Esq., M.I.C.E., Superintending Engineer, III Circle.
*To*—the Executive Engineer, Cuddapah Division.
*Dated*—Bellary, the 12th February 1898.
*No.*—5993.

[*Reference.*—His letters No. C. 282 of 11th May 1897 and No. 4633 of 14th January 1898.]

From the reports connected therewith it seems that water sufficient for 2,500 acres could be stored with F.S.L. 50 feet above the river bed (proposed Dorigallu reservoir). It seems certain that the heavy occasional run-off from 500 square miles of catchment should be passed over a masonry dam formed across the river. Consequently the cost of such a scheme would be heavy, much more than as stated by the Executive Engineer in his former letter. The cost would, it is believed, be between 3 and 4 lakhs or out of all proportion to the results expected. For it seems by no means certain that even 2,500 would be cultivated wet.

Conductor Ulyett's proposal to raise the Dorigallu tank 6 feet would provide storage for an extra 160 acres. But it is believed the cost would be out of proportion.

The F.T.L. in tank would then be + 294, while the offtake of the proposed feeder channel + 319 or 19 feet above river-bed.

So unless a channel could be taken off at river-bed level or else by means of a low anicut, even this scheme does not look hopeful. However this and Mr. Murray's proposal to irrigate by means of direct channels should be investigated and the probabilities of extending the wet cultivation thereby, inquired into.

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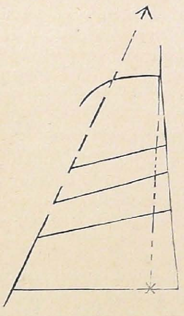
## V

**Memorandum No. III/24 C.D., dated 18th May 1898.**

The undersigned agrees with the Superintending Engineer that it would be unsafe to build on a rocky bed an earthen dam to retain 50 feet of water. Conductor Ulyett, to whom much credit is due for the way he has got up the project, has made his investigation on the supposition that an earthen dam could be built and has consequently not made any attempt to ascertain the level of sound rock. There are, however, indications that sound rock will be found not very far below the surface over a length (say, 600 feet) sufficient for the discharge of the surplus and the remainder of the dam might be made of earth.

2. The waterspread of the reservoir would unfortunately be small compared with the height of bund and it might be seen how much would be added to the capacity by making the F.S.L. 360 and whether by extending the channels a sufficiently large area to utilise all the water could be commanded. A rough estimate will do for the present. In making the estimate for the dam a bottom width of about seven times the height to M.W.L. had better be provided or two-thirds height exclusive of front batter of 1 in 20. The width of crest over which water will pass may be made 9 feet.



3. It should be ascertained what area there is under existing tanks above the reservoir site in order that it may be judged to what extent they are likely to intercept the water for the 400 square miles which drains into them.

4. The alternative project of direct irrigation need not be further investigated at present as existing rights cannot be interfered with and it seems quite impossible that the river could be depended on to supply 95 cubic feet per second for 8 months in the year. The best rivers in the Presidency have not anything approaching such a flow from the same area of free basin during so long a period. If the reservoir project

be found not feasible the flow of the river may be ascertained by actual measurement and arrangements can then be made for utilising whatever water there may be in excess of present claims.

W. Hughes,
*Chief Engineer for Irrigation.*

To the Superintending Engineer, III Circle.

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## VI

*Letter*—from Lieut.-Col. W. L. C. Baddeley, R.E., Superintending Engineer III Circle.
*To*—the Chief Engineer for Irrigation.
*Dated*—Bellary, the 3rd June 1898.
*No.*—776 I.

In reference to your No. III/24 C.D. of 18th May 1898, I have the honour to ask for an explanation of the instructions given (in the concluding portion of paragraph 2) for making the estimate for the dam.

Two dams would be required—one of earth, the other of masonry—and I presume the base of the former is to be seven times the height to M.W.L. ?

As regards the latter the batter of the rear slope is not stated, and the width of the base depends upon this as well as upon the front batter and height to M.W.L.

Among the papers sent to you with this office No. 467 I. of 9th May 1898 was a report on the project by Conductor Ulyett. Only the 17 plans have been returned and I shall be obliged if you will forward the report to me. I cannot find among the reports on the project any mention of the fact that a large reservoir in the Muddaleru river would affect seriously the supply of the Pennér, which river is now barely sufficient for the irrigation under it in the Nellore district.

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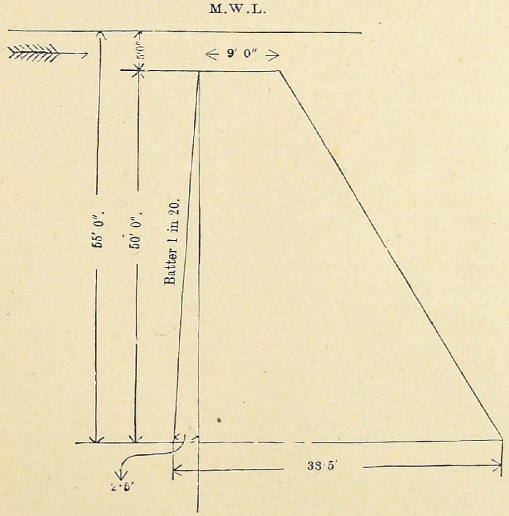
## VII

### Memorandum No. III/29 C.D., dated 13th June 1898.

With reference to his No. 776 I., dated 3rd instant, the undersigned has the honour to inform the Superintending Engineer that the instructions given in paragraph 2 of this office Memorandum No. III/24 C.D. of 20th May referred only to a method of making a rough estimate of the cost of the masonry part of the dams, thus :—




Suppose the height of dam required were 50 feet and M.W.L. 5 feet above top of dam. The instructions given were to make the bottom width of the dam about ·7 times the height to M.W.L. or in the case now taken about $\cdot 7 \times 55 = 38\cdot 5$ feet to make top width 9 feet and front batter 1 in 20.

These instructions fix the section of dam to be allowed for, which

would be of the dimensions shown in the marginal sketch ; an alternative method of fixing the bottom width was given as $\frac{2}{3}$ of the height exclusive of the front batter of 1 in 20 or in the case taken $(\frac{2}{3} \times 55) + 2{\cdot}5 = 39{\cdot}1$ feet. If the project be found to be feasible and a detailed estimate comes to be prepared the section of the dam will be designed on the usual calculations.

The suggestion made was that a masonry dam might possibly be built on solid rock for a length of about 600 feet and over which the surplus would pass, that is, if suitable rock is found being connected with earthen banks on one or both sides according to slope of ground by wing walls. No instructions were given as to the section of the earthen portion of the dam which must depend on nature of soil, etc., available, ample allowance may be made in the rough estimate.

As requested Conductor Ulyett's report is forwarded herewith and it is requested that it may be returned with the information asked for in this office Memorandum No III/24 C.D., dated 20th May 1898.

As the object of this project and similar projects which are now being investigated is to store some of the flood water which now runs to waste every year into the sea, the objection pointed out by the Superintending Engineer in the last sentence of his letter need not bar the investigation now proposed, although it may be necessary to take the interests of lower works into account.

W. Hughes,
*Chief Engineer for Irrigation.*

To the Superintending Engineer, III Circle.

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## VIII

*Letter*—from Lieut.-Col. W. L. C. Baddeley, R.E., Superintending Engineer, III Circle,
*To*—the Chief Engineer for Irrigation.
*Dated*—Bellary, the 8th November 1898.
*No.*—2937 I.

In reference to your No. III/24 C.D. of 20th May 1898, I have the honour to forward a report by Conductor Ulyett giving the additional information asked for with regard to the proposed reservoir on the Muddaleru.

2. The bund should apparently be extended along A B—*vide* $\frac{I}{3}$ sheet E as this will give an increase of 301 millions of cubic feet sufficient for about 1,500 acres of rice land.

3. The line along the ridge does not give as much storage, but the waterspread is considerably less.

4. By fixing F.T.L. at + 360 a very good reservoir can be formed.

5. The sections of the river and trial pits show that a masonry dam can be constructed ; but I believe it is now considered that a rock foundation is not an insuperable objection to an earthen dam. The matter has been recently discussed, I think, at the Institute of Civil Engineers, and I hope soon to obtain a copy of the Proceedings. Your suggestion for a masonry dam of 600′ is to enable the surplus to be passed over the work, but if a portion of the surplus can be discharged over the ridge on the left flank of the reservoir—*vide* tracing $\frac{S}{3}$, the balance might be passed through the dam, thus enabling the reservoir to be emptied if required. Leaving the question of the nature of the dam to be decided hereafter, it seems clear that the project is a good one and should be worked out in detail. The extension of the channels will bring a large additional area, at least 2,000 acres, under cultivation.

6. I return all the original plans and papers as sent with Mr. Ulyett's first report and forward the additional plans and papers connected with his present report.

## IX

### Memorandum No. III/4 C.D., dated 23rd January 1899.

When it is considered that the annual rainfall at Kadiri varies from 8 to 71 inches while the average is under 28, it seems necessary in order that a fairly good crop may be obtained in bad years to make the capacity of the Dorigallu reservoir something more than can be expected to be obtained in a year of average rainfall. The full supply level 360·0 which gives a capacity roughly estimated at 707 millions cubic feet seems on the whole suitable to give a fairly regular supply to at least 2,500 acres. It would apparently not pay to carry the bund on the left flank across the minor valley draining to Dorigallu tank as this would apparently increase the capacity by only 301–273 or 28 millions cubic feet and to make this available a deep cutting would be required to connect the two valleys.

2. The undersigned cannot see any way of disposing of the large quantity of flood water 4 cubic feet over the dam and for this reason at least the greater part of the dam must be of masonry. The reports are defective in one very important respect, the geological features of the site not being sufficiently described. As far as can be gathered from the sections the hills consist of some kind of schistose rock overlying granitic rock, which is exposed only in the river bed and the question is whether the schistose rock is sufficiently water-tight to admit of a masonry or earthen dam being built on it. The Superintending Engineer should have this question investigated by a competent officer. It may be sufficient to make a masonry dam some 600 feet in length on the granite with wings joining it to an earthen dam with a core wall sunk some distance into the schistose rock.

Apparently only high level channels at 316 or higher would be practicable as they would have to be kept above the flood level of the river corresponding to anticipated flood over the dam. Some of the capacity would of course have to be sacrificed.

The Superintending Engineer is requested to reconsider the project in the light of the above remarks. It may be that there is a better site somewhat higher up the river where the width at the 360 contour appears rather less than at the site investigated.

W. HUGHES,
*Chief Engineer for Irrigation.*

To the Superintending Engineer, III Circle.

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## X

*Letter*—from Lieut.-Col. W. L. C. BADDELEY, R.E., Superintending Engineer, III Circle.
*To*—the Chief Engineer for Irrigation.
*Dated*—Bellary, the 8th November 1899.
*No.*—4085 I.

In reference to your No. III/4 C.D. of 23rd January 1899, I have the honour to forward a copy of letter No. 154 S.E. of 30th September 1899 from the Executive Engineer, Cuddapah division, with 49 enclosures as per list attached.

2. I am of opinion that a masonry dam is out of the question on account of the cost, even if it was necessary to pass the surplus over the dam. A masonry dam 600 feet in length joined on to earthen banks would be a most expensive arrangement for a reservoir to irrigate about 2,500 acres.

3. I see no objection to forming the bund of earth with a masonry core, but it is hopeless to think of making detailed plans and estimates until the Cuddapah Division office has been strengthened. The drawing establishment available at present is one draftsman and he cannot attend to one-half of the current work.

ENCLOSURES.

*Letter*—from A. H. Morin, Esq., Executive Engineer, Cuddapah Division.
*To*—the Superintending Engineer, III Circle.
*Dated*—the 30th September 1899.
*No.*—154 S.E.

With reference to your No. 806, dated 23rd February 1899, forwarding Chief Engineer's Memorandum No. III/4 C.D., dated 24th January 1899, in connection with the Dorigallu Project, I have the honour to report that I do not think a more suitable site for the dam can be found higher up.

The valley narrows and the slopes steepen as you go further up, and capacity would be sacrificed in proportion.

The proposal to bund up the minor parallel valley is not so much with the idea of increasing the capacity as to facilitate the disposal of the surplus.

Referring to the block survey of the whole project which Mr. Ulyett has prepared for ready reference, the idea is to allow the surplus to find its way over the ridge A.C. (which is for the most part below + 360·0, the proposed F.T.L. and which would soon scour down to a lower level) and gradually fill the minor valley which would thus act as a flood moderator. The proper length of escape would thus be provided in the ridge B.D. which could be done without difficulty or expense and the surplus instead of returning to the river in the immediate neighbourhood of the dam, a source of danger, would be kept quite clear of it by flowing down the Dorigallu tank watershed, at the same time vastly improving the supply to that tank. The whole capacity of the minor reservoir could also be utilized by means of a high level sluice in the bund across it.

Situated as the Dorigallu tank is between two high ridges, its bund and F.T.L. could be considerably raised at a comparatively small cost and a very respectable reservoir formed.

If necessary a portion of the surplus could easily be passed at the right flank of the reservoir but it would flow across the irrigation channels.

If it is not considered advisable to allow the surplus to flow into the Dorigallu tank it could be passed into the river near the point L, or a portion of it might be let out here, and the remainder passed into the tank. The overfall over the ridge near L or that on the right flank of the tank would be much less than that over the masonry dam suggested by the Chief Engineer.

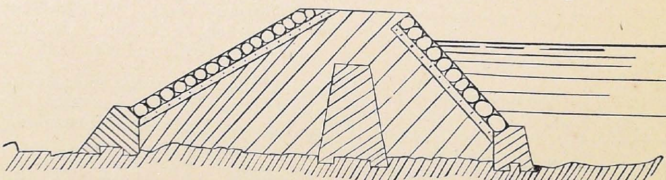
I am much opposed to the idea of a masonry dam at all and still more so to the idea of surplussing over it.

The cost of such a dam, involving, as it would, enormous wings would be quite prohibitive and the foundations would be very difficult.

There is no level sheet of rock across the river bed, but an irregular out-crop of trap. Overlying this on the flanks is a fairly uniform stratum of granitic rock. I have examined all the trial pits and in the sheet showing the sections of these $\left(\frac{T}{3}D \text{ and } \frac{T}{3}E\right)$ I have added explanatory notes.

Except for the central 600′ the conditions are quite of the ordinary nature and there is no objection whatever to the construction of an earthen bund.

For the 600′ of the river bed proper, I consider that an earthen bund might be constructed with a core wall of masonry in the centre, well seated on the rock, and with low masonry retaining walls at both toes, the outer one being of the stronger section (*vide* sketch). Both slopes of the bund could be revetted and there should be no fear of leakage.



If the surplus is passed otherwise than over the centre of the bund the low level channels will not be interfered with.

All the papers and plans sent with your number under reference are returned herewith.

## XI

### Memorandum No. III 1 C.D., dated 8th January 1900.

With reference to the Superintending Engineer's No. 4085 I., dated 8th November 1899, it is requested that an estimate may be prepared for the Dorigallu Project as soon as conveniently practicable, on the lines recommended in the Executive Engineer's No. 154 S.E., dated 30th September 1899. Provision should be made for the thorough drainage of the bund in rear of the core wall. If the retaining wall proposed by the Executive Engineer is found necessary there should be openings to let leakage pass freely.

W. HUGHES,
*Chief Engineer for Irrigation.*

To the Superintending Engineer, III Circle.

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## XII

To the Superintending Engineer, III Circle, dated 7th August 1903, No. 11/III

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## XIII

### Memorandum No. 47/Spl., dated 7th August 1903.

The Superintending Engineer, III Circle, having represented that the investigation of the Dorigallu project, Cuddapah district, described on pages 73 and 74 of Mr. Clerk's Preliminary Report cannot be undertaken by the ordinary establishment of the Cuddapah division, the undersigned has the honour to request that the Superintending Engineer on Special duty will be so good as to include the project in the list of works to be investigated by him. The Superintending Engineer, III Circle, has been asked to send to the Special Superintending Engineer any reports or other papers likely to be of use now.

J. P. DAVIDSON,
*Chief Engineer for Irrigation.*

To the Superintending Engineer on Special duty.

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## XIV

*Letter*—from J. H. MEDLICOTT, Esq., Superintending Engineer on Special duty.
*To*—the Chief Engineer for Irrigation.
*Dated*—the 14th August 1903.
*No.*—1369.

In reply to your Memorandum No. 47-Spl., dated 7th August 1903, I have the honour to inform you that, as stated in the report that accompanied the estimate for 1903–1904 sent with this office No. 25, dated 9th January 1903, the Dorigallu project has been included in the programme of work to be done by the Kurnool-Anantapur Investigation Party during the current year. The investigation of this scheme and of the projects in the Anantapur district will be commenced as soon as the Assistant Engineer I have advertised for is appointed.

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## XV

To the Superintending Engineer, III Circle, dated 20th August 1903, No. 12/III.
,, ,, ,, on Special duty, dated 8th June 1904, No. 70/O.

## XVI

*Letter*—from J. H. MEDLICOTT, Esq., Superintending Engineer on Special duty.
*To*—the Chief Engineer for Irrigation.
*Dated*—the 16th June 1904.
*No.*—966.

With reference to your Memorandum No. 70-O, dated 8th June 1904; I have the honour to state that no investigations in Cuddapah have been undertaken by me.

2. I enclose herewith for your information extract from letter No. 1812 C, dated 3rd September 1903, from the Executive Engineer, Cuddapah Division, to the Superintending Engineer, III Circle, in connection with the Dorigallu project.

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ENCLOSURE.

*Letter*—from G. B. LAMBERT, Esq., Executive Engineer, Cuddapah Division.
*To*—the Superintending Engineer, III Circle.
*Dated*—the 3rd September 1903.
*No.*—1812 C.

With reference to your memo. No. 2536, dated 12th August 1903, requesting to send all papers in connection with the Dorigallu project to the Superintending Engineer on Special duty for investigation, I have the honour to report that the investigation has been completed and that only a few levels are required for the completion of the estimate, which I will submit as early as possible. There is therefore no necessity to send to the Superintending Engineer on Special duty.

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## XVII

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| To the Superintending Engineer, | | | III Circle, | dated | 12th July 1904, No. 126-O. | | |
| From the | ,, | ,, | III | ,, | ,, | 15th September 1904, No. 3256-I. | |
| ,, | ,, | ,, | III | ,, | ,, | 25th ,, ,, ,, | 3368-I. |
| To the | ,, | ,, | III | ,, | ,, | 29th ,, ,, ,, | 3238. |
| From the | ,, | ,, | III | ,, | ,, | 26th May 1905, No. 1959. | |

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## XVIII

**Memorandum No. 1751, dated 3rd June 1905.**

The Chief Engineer for Irrigation has the honour to observe that in his letter to the Superintending Engineer, No. 1812-C, dated 3rd September 1903, the Executive Engineer, Cuddapah Division (Mr. Lambert), reported that the investigation of the Dorigallu project had been completed. Accordingly the Superintending Engineer was asked in Memo. No. 126-O, dated 1st July 1904, to expedite the submission of the plans and estimates for the project In reply, the Superintending Engineer forwarded letter No 1758-C, dated 21st September 1904, from the Executive Engineer in which it was reported that the investigation of the project was far from complete and that it could not be hoped to have an estimate ready in less than three months. In his letter under reference the Superintending Engineer reports that the project is still under investigation and that a survey of a new site for the dam is now in progress. From the above statements it cannot be made out how far the investigation of the project has progressed and why it is necessary to make a survey of a new site for the dam. The Superintending Engineer is therefore requested to be so good as to report the reason for the change of site, the present state of progress in the investigation and when the plans and estimates may be expected in this office.

A. H. GARRETT,
*Chief Engineer for Irrigation.*

To the Superintending Engineer, III Circle.

## XIX

*Letter*—from J. M. LACEY, Esq., Executive Engineer, Cuddapah Division.
*To*—the Superintending Engineer, III Circle.
*Dated*—the 13th June 1905.
*No.*—3454.

Referring to your No. 2110, dated 6th June 1905, I have the honour to inform you that the plans and levels for the Dorigallu project were completed except in a few details by Conductor Ulyett. His proposals were to make the dam of earth with a core wall as the chief difficulty was suitable earth for the dam. I have made a survey of another site about 3 furlongs higher up where the river flows over a barrier of rock for a combined masonry and earth dam. These surveys and levels will shortly be ready.

As regards the preparation of the estimate, I will endeavour to submit the same as early as possible within the next three months —by 1st October if possible.

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*No.* 2271, *dated* 17*th June* 1905.

Communicated to the Chief Engineer for Irrigation for information in reference to his No. 1751, dated 3rd June 1905.

G. F. HANDCOCK,
*Offg. Superintending Engineer, III Circle.*

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## XX

From the Superintending Engineer, III Circle, dated 3rd July 1905, No. 2436.
.. ,, III ,, ,, 16th December 1905, No. 4756.

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## XXI

*Letter*—from G. F. HANDCOCK, Esq., Superintending Engineer, III Circle.
*To*—the Chief Engineer for Irrigation.
*Dated*—Camp, Kurnool, the 20th January 1906.
*No.*—258.

I have the honour to submit plans and estimate for the Dorigallu project as prepared by Mr. J. M. Lacey.

(1) The project consists in the construction of a reservoir to store 2,120 millions cubic feet for the irrigation of 10,000 acres of first crop and 1,000 acres of second crop at a cost of Rs. 9,00,000.

(2) Mr. Lacey has selected a site 3 furlongs higher up the stream than that originally selected.

(3) In paragraph (2) Mr. Lacey has apparently made an error in quoting from his earlier report—the run-off should be 10 per cent. of the south-west and 15 per cent. of the north-east monsoons, respectively, and not 15 and 20 per cent. as assumed in the report accompanying the estimate—

10 per cent. of 14·28″=1·43″

15 per cent. of 8·26″=1·23″

The catchment area is 500 square miles. Therefore the run-off during the south-west monsoon would be 1,650 millions cubic feet and 1,450 millions cubic feet during the north-east monsoon, *i.e.*, a total of 3,100 millions cubic feet.

There are 68 intercepted tanks with an ayacut of 4,896 acres requiring 980 millions cubic feet. Thus the total quantity of water available for the new reservoir would be 2,120 millions cubic feet which should be sufficient for the ayacut of 10,000 acres proposed by the Sub-Collector.

(4) As the Collector states there would certainly be 1,000 acres of second crop near the bund. Thus the revenue would be—

| | | RS. |
|---|---|---|
| 10,000 acres of first crop at Rs. 4 per acre ... ... ... | | 40,000 |
| 1,000 acres of second crop at Rs. 2 per acre ... ... ... | | 2,000 |
| | Total ... | 42,000 |
| Amount of estimate ... ... ... ... ... ... ... | | 9,00,000 |
| Establishment and tools and plant at 24½ per cent. ... ... | | 2,20,500 |
| Leave and pension allowances ... ... ... ... | | 30,000 |
| Abatement of land revenue ... ... ... ... ... ... | | 3,500 |
| | Total ... | 11,54,000 |

on which a revenue of Rs. 42,000 would give a return of 3·6 per cent.

(5) Mr. Lacey has omitted to provide drains for the rear slope of the dam, as the length of the rear slope is 140 feet in the highest portion of the dam, a system of drains would appear to be very necessary, I have therefore provided accordingly.

(6) The present Sub-Collector, Mr. Coleridge, has held charge of the Madanapalle division for several years and has had more experience of this portion of the Cuddapah district than any other officer. His opinion on the project should therefore carry considerable weight. From the enclosed letter No. 3645, dated 30th September 1905, it will be seen that Mr. Coleridge strongly supports the project and is very sanguine as to the result.

(7) The Executive Engineer has been requested to obtain from the Collector legal agreements binding the ryots to irrigate lands as specified in statement C accompanying the Sub-Collector's report.

## XXII

*Letter*—from J. M. Lacey, Esq., Executive Engineer, Cuddapah Division.
*To*—the Superintending Engineer, III Circle.
*Dated*—Madanapalle, the 31st January 1906.
*No.*—658.

With reference to your No. 259, dated 20th January 1906, I have the honour to inform you—

(1) I increased the rate of run-off as the basin is only 500 and odd square miles against a basin of 21,000 square miles from which the calculations of run-off were made. If 10 per cent. of the south-west and 15 per cent. of the north-east is taken, no deduction should be made for the tanks above the proposed reservoir as the low percentage taken allows for these tanks.

(2) I intended first to provide drains in the rear slope, but as the soil is a poor red stony soil, it will be porous to a certain extent, and the ground sloping towards the river will enable any percolation through the core wall to be readily drained away—*vide* also Mr Hill's note on earthen reservoir at the Irrigation Conference. Providing drains however would be better.

(3) If we take agreements from the ryots binding them to take water, we will have to supply them with water; and if there is any failure, Government may be held liable to compensate the ryots for loss of water. This is contrary to the present policy of Government as laid down in Board's Standing Orders, viz., "That the privilege of benefiting by a new work is permissive on the part of Government, and that Government reserves to itself the full control and disposition of the supply"—*vide* Standing Orders of the Board of Revenue, Chapter VII, paragraph 84–2. Personally I am strongly against any fixed agreement, compelling the ryot to take water. It would be far better to allow the water to the ryot and encourage him to irrigate garden lands and dry crops, in addition to paddy; at the same time retaining full and complete control of its supply and distribution. I do not think that there will be any reluctance on the part of the ryots in taking the water, as the project is situated above the ghâts on the Mysore plateau, and not in the black-cotton plains of the main division.

*Endorsement, No.* 516, *dated 7th February* 1906.

Forwarded to the Chief Engineer for Irrigation in continuation of No. 258, dated 20th January 1906.

In reference to paragraph 3 of the Executive Engineer's letter, I think, before committing Government to a heavy outlay, a legal agreement of some kind should be obtained from the land-holders to the effect that they will irrigate certain specified lands if water is available. But such an agreement would not necessarily bind Government to supply water.

G. F. Handcock,
*Superintending Engineer, III Circle.*

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## XXIII

### Memorandum, No. 1258, dated 6th April 1906.

With reference to Superintending Engineer's No. 258, dated 20th January 1906, submitting plans and estimates for the Dorigallu project, the undersigned has the honour to remark as follows:—

The general idea of the project seems to be that of Conductor Ulyett adopted, without due consideration, to the new site proposed for the dam.

The information submitted is insufficient to allow of a judgment being formed as to the suitability of the general arrangement or the sufficiency of the estimates and is more particularly deficient as regards the surplus arrangements and distribution; among other matters, the following points must be reconsidered and the required information obtained and submitted:—

*Surplus arrangements.*—The surplus weir is placed on the left flank of the dam and provides for the discharge of 40,000 cusecs.

The allowance seems ample, being 50 per cent. of the maximum rainfall falling in 24 hours, but no consideration seems to have been given to the outfall arrangements. The vanka into which the discharge flows is evidently far too small to carry it and the water will apparently spread over cultivated land and do a great deal of damage, for which no allowance is made in the estimate. Further, no arrangements have been made for passing the left bank channel either over or under the surplus which would be a very expensive matter. This will be considered further on.

As regards the distributaries the position of the sluices are not shown in the plans of the dam nor anywhere else, the contours of the channel are only taken up to the old site of the reservoir and the sill level of one channel comes at river-bed level and of another only 5 feet higher.

The object of placing these head sluices at so low a level has not been stated and the position cannot be defended, the storage capacity at such a low level is negligible and the reservoir would soon silt up to the above sill levels. There seems no object whatever in placing any sill below 320 and the channel on the left bank might well take off at 330 and be kept above the course of the surplus channel.

To return to the question of the surplus channel without further contours and cross sections the exact line cannot be laid down; as at present shown part of the surplus might flow along the outer toe of the dam back to the river this may be prevented by a wall (A B on large survey), connecting the dam with the high ground in rear. The left bank distributary might be cut from the 330 contour in the tank along the line C D E, and the weir moved towards the river. Complete levels, contours and cross sections must be taken and the whole matter carefully threshed out. As regards the right bank distributaries that at the 330 contour commands all the land and the 310 contour channel seems quite unnecessary.

These channels should be estimated for in detail; the allowance of Rs. 2 an acre is probably far below the mark. The area to be irrigated under each sluice should be noted on the large map.

A map showing the whole project including catchment basin to a scale of 2 miles to the inch should be submitted. Instead of the sections submitted for masonry and earthen dams, those now sent, plans 1A, 1B, 1C, 1D, should be adopted. As regards the masonry dam the vented portion section 1A will extend for the length of 18 feet for each sluice, for the remainder section 1B will be adopted. Section 1D will be used for the earthen portion.

The question of rates does not appear to have received any consideration at all, no data sheets have been submitted and the allowances of 12 and 13/8 for rubble masonry in surki mortar, of the quality necessary for a high masonry dam, are quite impossible. It is the duty of all officers to submit to Government estimates giving a fair idea of the probable cost of the work which the present estimate cannot be said to do.

It is not clear whether the rate for earthwork includes the necessary allowances for a tramway or other means of bringing it to site ; in this case also the rates seem lower than that at which the work could possibly be done.

The questions referred to in paragraph 863 of Public Works Code should be answered seriatim.

The levels at which hard rock is met with should be given on the longitudinal section B to the full length of the dam and the weir. The sluices should be provided with shutters of Stoney's pattern. A tabular statement showing the extent of cultivation and the carrying capacity of each channel should be submitted. Detailed plan of the weir portion with wings should be prepared and submitted on a large scale with longitudinal and cross sections of the outfall channel.

F. J. WILSON,
*Chief Engineer for Irrigation.*

To the Superintending Engineer, III Circle.

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## XXIV

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|---|---|---|---|---|---|---|---|---|
| To the Superintending Engineer, | III Circle, | dated | 18th July | 1906, | No. | 2605. |
| From the ,, | III ,, | ,, | 28th Aug. | ,, | ,, | 4103. |
| To the ,, | III ,, | ,, | 11th Sept. | ,, | ,, | 3257. |

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## XXV

*Letter*—from G. F. HANDCOCK, Esq., Superintending Engineer, III Circle.
*To*—the Chief Engineer for Irrigation.
*Dated*—Bellary, the 24th October 1906.
*No.*—5272.

In reference to your memorandum No. 1258, dated 6th April 1906, I have the honour to inform you that I inspected the sites proposed for constructing a dam across the Muddaleru near Dorigallu in June last and requested the Executive Engineer to have a large survey taken to show all suitable sites for a dam and cross sections at the site originally selected by Conductor Ulyett (marked A) that selected by Mr. Lacey (marked B) and a site a little higher up selected by me (marked C).

These are herewith submitted for information and consideration.

2. The advantages and disadvantages in the case of each site may be stated as follows :—

A. Greatest capacity at the 20 feet contour--140 millions cubic feet more than at B, and 200 millions cubic feet more than at C. Two fillings in a year would store more than sufficient for 10,000 acres of "wet" cultivation.

The lead for carriage of earth and therefore the rate for earthwork would be less than at B or C. But the total quantity of earthwork and masonry would be considerably more than at B or C.

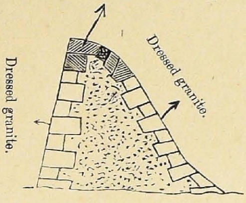
B. The rocky bed of the stream is at a comparatively higher level here than at A or C. Little or no expenditure is necessary in preparing or exposing the surface of the rock for the seat of the dam.

The lead for earthwork would be about 3 furlongs longer than at A, but the quantity would be much less.

With two fillings the capacity at the 20 feet contour would just suffice for 10,000 acres.

C. The total quantities of earthwork and masonry at this site would be much less than at A or B, but the storage with two fillings would not be sufficient for 10,000 acres.

3. The river bed is composed of "Schistose quartzite" with indentations of "Dolerite" which would form a splendid apron for an overfall. I am therefore strongly in favour of surplussing over a masonry wall to be built across the river. Such an arrangement would be infinitely preferable to and far cheaper than surplussing from either flank as it would save the necessity of excavating a surplus channel in rear.




4. I would also recommend that the section of the weir wall be as sketched in margin (*vide* Mr. Lacey's note at the end of his data sheet).

The core to be of concrete stone in surki mortar. The crest to be faced with "Dolerite" or trap stone and the remainder to be faced with grey granite dressed.

The site for the proposed dam is much out of the way, and considerable difficulty will be experienced in procuring skilled labour except at great cost. Hence the advantage of "concrete" in place of random rubble.

5. In reference to the question of rates, whichever site happens to be finally approved, it will be advisable to lay down a tramway for the carriage of earth, as suitable earth is only obtainable at some distance below A.

In the data sheet now submitted Mr. Lacey has revised and increased the rates for "concrete in mortar" and "masonry" but I am of opinion that it would be advisable to still further increase these rates by provision for ½ mile "lead" in the case of all materials obtainable at site.

For the composition of mortar, Mr. Lacey has provided 1 surki, 2 lime and 3 sand, whereas 1 surki, 1½ lime and 2 sand is the customary proportion in this circle.

6. Before proceeding with the preparation of complete plans and estimates early orders are requested on the various points now submitted for your consideration.

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## XXVI

### Memorandum No. 4332, dated 9th November 1906.

With reference to letter No. 5272, dated 24th October 1906, from the Superintending Engineer, III Circle, the Chief Engineer for Irrigation has the honour to observe that the Superintending Engineer in his last paragraph asks for instructions on "the various points submitted for consideration"; but it is not at all clear what points he refers to.

2. Apparently the Superintending Engineer wants the Chief Engineer for Irrigation to select a site for a dam across the Muddaleru but if so the information given is altogether too indefinite. It is necessary that some sort of estimate of cost should be made for each of the sites proposed and their relative merits and defects clearly stated with a definite opinion by the Superintending Engineer (who has

inspected the place) as to which site he would recommend. The proposal to surplus over the dam is approved if it is quite certain that no more economical arrangement is feasible.

The cost of a surplus channel would probably be very little as most if not all the material excavated from it would be available for the bund if suitable.

3. Considering the heavy section which will be necessary for the weir portion and the large amount of masonry in the wings in the position marked the desirability of lengthening the dam so as to get wings of less height should be considered.

(By Order.)

T. W. S. SMYTH,
*Asst. Chief Engineer for Irrigation.*

To the Superintending Engineer, III Circle.

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## XXVII

*Letter*—from P. ROSCOE ALLEN, Esq., M.I.C.E., Superintending Engineer, III Circle.
*To*—the Chief Engineer for Irrigation.
*Dated*—Bellary, the 2nd May 1908.
*No.*—3181.

I have the honour to inform you that I have now sufficient preliminary information available relative to the Dorigallu project in order to refer the matter to you for final orders.

2. You will be aware that I found that three sites for a dam had been chosen by three different people and that an estimate for a reservoir at Mr. Lacey's site had been compiled and plans drawn up which you had referred back to this office. The project on the lines drawn up by Mr. Lacey, did not seem very promising.

3. I had a longitudinal section taken of the river which indicated three possible sites for a reservoir dam and several other suitable sites for a dam only. The sites indicated as possible sites for a reservoir dam are marked respectively sites Nos. 1 2, 3 chosen by Mr. Allen. You will note from the longitudinal section of the river that the fall of the river above these sites is such as to lead to the hope that a reservoir made with the dam at any one of these points would be fairly capacious. The longitudinal section indicates fit sites for a dam at the three sites proposed by Mr. Handcock, Mr. Lacey, and Conductor Ulyett, but it does not indicate that a dam built at any of these sites would give a capacious reservoir.

No map which was available gave me any assistance; nor could I get much assistance from the inspection of the country as it is most uneven and covered with a scrub jungle. I had therefore to have the whole valley contoured and submit herewith a contoured map with the above sites marked thereon.

4. You will see at once that the three sites I have chosen are quite prohibitive from the length of the bund which would be required. The two lower sites would have the further disadvantage of entailing the submergence of the village. We thus fall back on Mr. Lacey's site; not because it is likely to afford a good reservoir if a dam is built at such a site, but because it is a good site for a dam, and this seems to have led to the supposition that if a dam were to be built at such a site it would afford a good reservoir. It seems quite unnecessary to discuss further the sites selected by Conductor Ulyett and Mr. Handcock, as neither of them affords so good a site for a dam as Mr. Lacey's site and if a dam were built at either site the reservoir would be even of less capacity than at Mr. Lacey's site.

In his report on the project Mr. Lacey states that the capacity of the reservoir at the 370·00 contour (F.S.L.) would be 1,174 million cubic feet. The contours we have now taken show that Mr. Lacey was much mistaken. At the 370·00 contour we find a capacity of 696·34 millions cubic feet and at the 375·00 contour we find a

capacity only of 880·92 millions cubic feet. As you might expect from a study of the longitudinal section of the river, the waterspread is rather circumscribed and does not expand much even at these levels. At F.S.L. the waterspread is 32·75 millions of square feet; at M.W.L. it is 41·25 millions of square feet. The level of the sluice sill is 320·00 and the capacity at that level is about 10·10 millions of cubic feet; deducting this from 880·92 millions cubic feet leaves us a total impoundment at M.W.L. of 870·82 millions cubic feet which would be available for distribution. To arrange for an impoundment of 1,000 millions of cubic feet we should have to raise the M.W.L. some 5 feet more and then make arrangements to impound water up to the new M.W.L. Such an arrangement would afford us a reservoir impounding 1,000 millions of cubic feet which, with one filling, would be sufficient for the irrigation of 5,000 acres.

5. The amount of water available in the catchment area is a matter which has been so carefully gone into previously that I find I have nothing whatever to add. In G.O., No. 2153 W., dated 12th August 1901, the Special Superintending Engineer writes :—

"In ordinary years I anticipate that there will be enough for 5,000 acres and "in years of scarcity it will probably be possible to irrigate from one-fifth of the "area upwards according to the intensity of the draught."

With this I find I am in full agreement, and nothing has since been brought to light which would in any way throw doubt upon this conclusion.

Mr. Lacey, however, states in his report :—

"The site of the dam is shown in survey plan No. 1 and plan A: it will form "a reservoir storing water to contour 370·00 and having a capacity 1,174 millions cubic "feet; taking 200,000 cubic feet as a sufficient storage for one acre of rice (*vide* this "office No. 4602, dated 11th August 1905), the reservoir will be capable of irrigating "5,800 acres with one filling and 11,600 acres with two fillings to say nothing for a "supply left over for a second crop. From paragraph 2 it will be seen that the supply "available is more than sufficient to give the reservoir two fillings."

I would now point out that nothing has astonished me more since I became Superintending Engineer of this circle than occasional notes I come across in the reports accompanying estimates for the restoration or repair of tanks to the effect that: "therefore with two fillings it will supply the ayacut"; or "therefore with three fillings it will supply the ayacut." It does not seem to have entered into the heads of officers making these estimates to enquire into the likelihood of getting these two fillings or three fillings. My own experience of five years in Hyderabad where conditions are analogous in parts and more favorable in other parts, goes to show that two fillings or three fillings cannot be depended upon, and from enquiries I have made in my tours in this circle, I have arrived at the conclusion that it would be more correct to expect one filling in two years or one filling in three years than two or three fillings in one year. There certainly are years in which the catchment areas of tanks afford a sufficient run-off to fill the reservoir twice or even three times in one year, but the meteorological conditions do not ensure a replenishment coming just when wanted; rather the reverse, the second fillings will usually be found to follow the foot-steps of the first so quick as to arrive before the tank has emptied and so all go to waste. This is a most important matter in all works and more especially one on which so much depends. It means either that we shall obtain a certain return on our expenditure or else double that return. I have, therefore, gone into a careful study of the record of the rainfall in the catchment area of this proposed reservoir. The rainfall statistics at Kadiri which are available in my office go back to the year 1870 and the latest I have is for 1905. This will give us a fair idea of what can be expected. This record shows that in the years 1876, 1890, 1891, 1896 and 1899 the reservoir would probably not have filled at all. This, however, need not frighten us. In the years 1879, 1883, 1884, 1888, 1893, 1901, 1904 the reservoir would have filled once each year. In 1879 the reservoir would have filled in May and 1888 and 1901 in September and in the remaining years in October. It is necessary to take note of these vagaries because in all these years excepting

1879, when the reservoir would have filled once, the filling would only have come in time for a second crop, and even then come so far in advance of the time for planting the second crop that waste would have occurred in the *interim* from evaporation.

In all the remaining years the rainfall would have filled the tank more than once. In 1871, 1872, 1874, 1875, 1877, 1878, 1894, 1900, the reservoir would have been full all the time and there would have been water for second-crop also. In 1870, 1873, 1880, 1881, 1882, 1883, 1884, 1885, 1886, 1887, 1888, 1889, 1892, 1893, 1895, 1897, 1898, 1901, 1902, 1903 and 1904 there would have been no first crop at all because the reservoir would not have filled until too late in the year, or the amount of first crop would have been very much below the full ayacut, although the second crop would have been fairly full.

In many years, 1870, 1873, 1875, 1877, 1878, 1882, 1887, 1889, 1892, 1895, 1897, 1902 and 1903 the second filling would have followed so hard on the first that it would have surprised a full reservoir and all gone to waste.

Taking it on the whole, excepting in the few years given above when the reservoir would not have filled, we could have looked forward, during the above period, to one filling a year. It is, therefore, not too much to expect that in the future also one filling per annum could be expected.

It is quite worth while to note the dates on which these fillings would occur because the ryots of Cuddapah are not much given to trusting in Providence, and they rather prefer to wait and see sufficient water to ensure the maturing of the full ayacut crop impounded in the reservoir before they commence to sow. A study of the above would make it almost certain that there are a good many years in which they would not sow at all for the first crop; and a full reservoir of 1,000 millions of cubic feet would not give 5,000 acres of second crop.

In any case sufficient has been said above to demonstrate that it would never do to depend on more than 5,000 acres of crop with a reservoir of 1,000 millions of cubic feet capacity.

That land is available for irrigation has been clearly shown and so I need not further discuss the matter.

7. The returns expected on 5,000 acres at Rs. 4 per acre would amount to Rs. 20,000.

As already pointed the M.W.L. of Mr. Lacey's reservoir would have to be raised some 5 feet in order to impound 1,000 millions of cubic feet and even then shutters would have to be provided to impound all between F.T.L. and M.W.L. The cost of such a dam, with masonry at the centre and earth on the two wings, would come to Rs. 16,65,000. If self-acting shutters of the pattern made use of in Lake Fife were adopted, we would require 62 shutters which, approximately, would add another Rs. 2,00,000 to the estimate. Mr. Lacey seems to have considerably underestimated the cost of his dam as well as overestimated the capacity of his reservoir. I make the cost of his dam Rs. 14,62,000. If water were to be impounded in such a dam up to M.W.L. with similar self-acting shutters, then Rs. 2,00.00 would have to be added. Then then, a capacity of 880·92 millions cubic feet only would be impounded. The earth will have to be brought by tramway from a distance of 1½ miles. The site of the dam is very rocky, and the little earth there is, in the valley at site, is very sandy and untrustworthy for such work. The data given me for the earthwork is Rs. 8 per 1,000 cubic feet but I have increased this to Rs. 10 on account of the many difficulties that the execution of a work in such a place would afford. The site is six miles from the Moodigooba Railway station, South Indian Railway, in a lonely and very thinly populated place. The road connecting the site with the railway station is hardly fit for pack animals and the country is so rocky that it would be difficult to improve it. All bazaar stores would have to be brought along this road from a distance. The rate for the masonry which I have also increased from Rs. 17-8-0 to Rs. 23 is what my experience in other parts of Cuddapah leads me to suppose would be its cost. The data showing Rs. 17-8-0 does not, moreover, include the cost of lift and bu… mile haulage.

On the whole I am fully satisfied that my estimate is the least which the figure can be placed at considering all the circumstances of the case.

8. The ryots of the valley are much interested in the project, and would, undoubtedly, make full use of the water. This is, moreover, a part of the country where certain encouragement is very much needed, and the execution of this project would do very much more good than its estimated returns would lead any one to suppose. I, however, find this same thing in all irrigation projects; they are credited with the direct returns and rated accordingly, whereas the indirect returns, which are taken no account of, and with which the project is not credited, must be enormous. On the other hand, it is undoubtedly the case that the money now being spent on the Maidkur and Chepad channels, and that hereafter to be spent on Velgode, is a much better investment and seems to be giving the Cuddapah district all the encouragement which it requires for the present. Any pressure of population which there may be in any part could readily be relieved by migration to the lands commended by those channels where, in parts, population is decidedly needed.

On the whole, therefore, there does not seem to exist in the district such necessity as would warrant the outlay of so large a sum for such meagre returns and I recommend that the matter lie over for the present.

I request your orders on the matter.

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## XXVIII

**Endorsement No. 946-C/08-1, Revenue, dated 16th June 1908.**

Referred to the Collector of Cuddapah for remarks through the Board of Revenue A revenue forecast based on the differential water-rate system should be submitted.

(By Order.)

F. NOYCE,
*Ag. Asst. Secretary to Government.*

To the Collector of Cuddapah.

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## XXIX

From the Board of Revenue (Revenue Settlement), dated 25th August 1908, No. 2265.
To the „ „ „ 28th „ „ „ 946-C/08-2, Revenue

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## XXX

*Letter*—from P. R. ALLEN, Esq., M.I.C.E., Superintending Engineer, III Circle.
*To*—the Chief Engineer for Irrigation.
*Dated*—Kurnool, the 27th November 1908.
*No.*—8159.

I have the honour to inform you in continuation of this office No. 3181, dated 2nd May 1908, that some error seems to have crept into my estimate of Rs. 2,00,000 for the self-acting shutters. So far as I can ascertain the amount would be nearer Rs. 4,00,000 than Rs. 2,00,000. I would, however, suggest your making enquiries on the subject in a quarter where you are likely to get more exact information as I am not as well informed in the matter as I should like to be. The shutters proposed are similar in every way to those on Lake Fife near Poonah.

## XXXI

### Memorandum No. 4561, dated 12th December 1908.

With reference to his letter No. 8159, dated 27th November 1908, the Superintending Engineer, III Circle, is informed that the cost of Bhatghar sluices works out to about $4\frac{1}{4}$ rupees per cusec ; a rate of Rs. 5 per cusec of discharge which is that on which the estimate appears to have been worked out should suffice to cover all contingencies.

(By Order.)

T. W. S. Smyth,
*Asst. Chief Engineer for Irrigation.*

To the Superintending Engineer, III Circle.

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## XXXII

### Proceedings of the Board of Revenue (R. S. Sur., L. R. and Agri.), Mis. No. 849, dated 11th March 1909.

*Read*—the following papers :—

(i)

*Memorandum*—from Government, Revenue Department.
*Dated*—18th August 1908.

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(ii)

*Reference*—from the Board of Revenue (Revenue Settlement).
*Dated*—25th August 1908.
*No.*—2265.

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(iii)

*Memorandum*—from Government, Revenue Department.
*Dated*—28th August 1908.
*No.*—946-C./08-2.

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(iv)

*Reference*—from the Board of Revenue (Revenue Settlement).
*Dated*—5th September 1908.
*No.*—2359.

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(v)

*Letter*—from J. G. D. Partridge, Esq., I.C.S., Collector of Cuddapah.
*To*—the Secretary to the Commissioner of Revenue Settlement, Survey, Land Records and Agriculture.
*Dated*—12th February 1909.
*No.*—595-D. Rev.

In returning herewith the papers received with Government endorsement No. 946 C./08-1, Revenue, dated 16th June 1908, I have the honour to state that, in

preparing the lists of fields irrigable by the Dorigallu project furnished by the Sub-Collector to the Executive Engineer, the irrigable area was taken as 9,075 acres. The area has now been reduced by the Superintending Engineer to 5,000 acres, but no tracings from the village plans showing the revised area have been furnished. The areas irrigable in the several villages according to the original estimate were as shown below:—

| | ACS. |
|---|---|
| Dorigallu ... ... ... ... ... ... ... ... | 2,823 |
| Morathad ... ... ... ... ... ... ... ... | 2,251 |
| Shrotriam ... ... ... ... ... ... ... ... } | |
| Bandlapalle ... ... ... ... ... ... ... ... } | 1,339 |
| Kodavandlapalle ... ... ... ... ... ... ... | 2,662 |
| Total ... | 9,075 |

Both the proposed right and left bank irrigation channels irrigate the lands of Dorigallu first and then the lands of Morathad. The remaining two villages can get water only after Dorigallu and Morathad have been served. The extent irrigable in the latter two villages is 5,074 acres which is about the area estimated by the Superintending Engineer. The numberwar lists prepared for Dorigallu and Morathad have therefore been adopted for working out the revenue due to the project under the differential water-rate system.

2. The dry lands in the two villages are, according to the Settlement register, placed in the third group and the wet lands in the second. In estimating the revenue under the new tank, the wet rates of the first group have been adopted as irrigation sources with much smaller ayacuts than 5,000 acres are now found placed in the first group. A statement is submitted showing the areas under the different classes and sorts and the revenue that may be realised. It will be seen that on 4,800 acres of dry land a revenue of Rs. 15,588 may be expected. Two hundred and forty-seven acres of wet land now placed in the second group will, by reason of the group being raised to first at the re-settlement, pay an additional revenue of Rs. 180. Twenty-seven acres of inam wet land will give no increased revenue. The total increase is thus estimated at Rs. 15,768.

3. The nature of the supply in the Muddaleru river may be judged from the figures of cultivation and remission in the villages of Patnam, Dorigallu and Morathad in which almost the whole wet ayacut depends for irrigation on that river. The enclosed statement shows that in faslis 1311 to 1314, 36 *per cent.* of the revenue on the wet holdings was remitted in those villages and that the tirvajasti and fasaljasti revenue amounted only to 3 and 1 *per cent.* respectively. In faslis 1316 and 1317, no remission was granted and the tirvajasti and fasaljasti revenue amounted to 11 and 2 *per cent.* respectively of the assessment on the occupied wet area. Under the circumstances, I agree with the Superintending Engineer that it is not safe to assume that the supply will be able to support on the average more than one wet crop every year. Possibly, a small percentage may have to be deducted on account of deficient supply, but as there are facilities for extension of irrigation and as the supply stored in a big reservoir by bunding up the river will be more assured than the present supply which is obtained from the river by means of supply channels or by putting up temporary bunds, I think it will be sufficient to exclude from the estimate diminution of revenue from remissions or increase on account of water-rate and to calculate the revenue by taking into account the water-rate for a single wet crop. The revenue may accordingly be taken as Rs. 15,000. Even taking the lower of the two figures given by the Superintending Engineer as the estimated cost of the project, the return from the proposed outlay will be less than 1 *per cent.* The work cannot be taken as a productive work and I think that it might be possible to find more promising projects in the sub-division for the purpose of affording some protection against famine. I have some doubts whether, in the absence of leaf manure, the ryots could bring such a larger area under wet cultivation.

## Enclosure.

| Names. | Holdings. | Assessment. | Cultivation. | Waste. | Remitted. | Tirvajasti. | Fasaljasti. | Other remissions. | Remarks. |
|---|---|---|---|---|---|---|---|---|---|
| | ACS. | RS. A. P. | ACS. | ACS. | RS. A. P. | RS. A. P. | RS. A. P. | RS. A. P. | |
| Dorigallu .. .. .. .. | 189·94 | 681 12 0 | 56·59 | 133·35 | 448 6 0 | 2 4 0 | 1 9 0 | 15 13 0 | |
| Morathad .. .. .. .. | 30·71 | 116 9 0 | 8·66 | 19·32 | 48 4 0 | 13 12 0 | .. | 11 6 0 | 1311 fasli. |
| Patnam .. .. .. .. | 423·81 | 2,225 11 0 | 139·22 | 282·39 | 1,401 8 0 | 17 14 0 | 19 10 0 | 45 7 0 | |
| Total .. | .. | 3,024 0 0 | .. | .. | 1,898 2 0 | 33 14 0 | 21 3 0 | .. | |
| Dorigallu .. .. .. .. | 185·78 | 671 6 0 | 90·58 | 89·82 | 286 12 0 | 1 11 0 | 44 4 0 | 72 8 0 | |
| Morathad .. .. .. .. | 30·71 | 116 9 0 | 26·68 | .. | .. | 8 8 0 | .. | 11 6 0 | 1312 fasli |
| Patnam .. .. .. .. | 424·40 | 2,230 8 0 | 263·56 | 154·61 | 671 8 0 | 42 15 0 | 17 11 0 | 57 12 0 | |
| Total .. | .. | 3,018 7 0 | .. | .. | 958 4 0 | 53 2 0 | 61 15 0 | .. | |
| Dorigallu .. .. .. .. | 185·78 | 671 6 0 | .. | .. | .. | 96 13 0 | 53 2 0 | 117 5 0 | |
| Morathad .. .. .. .. | 30·71 | 116 9 0 | .. | .. | .. | 69 10 0 | .. | 11 6 0 | 1313 fasli |
| Patnam .. .. .. .. | 434·95 | 2,278 9 0 | .. | .. | .. | 105 11 0 | 41 2 0 | 58 3 0 | |
| Total .. | .. | 3,066 8 0 | .. | .. | .. | 272 2 0 | 94 4 0 | 186 14 0 | |
| Dorigallu .. .. .. .. | 185·78 | 671 6 0 | .. | 132·91 | 452 15 0 | 1 15 0 | .. | 28 6 0 | |
| Morathad .. .. .. .. | 30·71 | 116 9 0 | .. | 18·94 | 47 5 0 | .. | .. | 11 6 0 | 1314 fasli. |
| Patnam .. .. .. .. | 436·9 | 2,287 8 0 | .. | 226·3 | 1,061 8 0 | 8 6 0 | 5 6 0 | 149 12 0 | |
| Total .. | .. | 3,075 7 0 | .. | .. | 1,561 12 0 | 10 5 0 | 5 6 0 | .. | |
| Dorigallu .. .. .. .. | 185·78 | 671 6 0 | .. | .. | .. | 170 8 0 | 15 7 0 | 110 9 0 | |
| Morathad .. .. .. .. | 30·71 | 116 9 0 | .. | .. | .. | 37 2 0 | 18 5 0 | 11 6 0 | 1316 fasli. |
| Patnam .. .. .. .. | 438·26 | 2,317 10 0 | 406·84 | .. | .. | 117 1 0 | 15 2 0 | 140 6 0 | |
| Total .. | .. | 3,105 9 0 | .. | .. | .. | 324 11 0 | 48 14 0 | .. | |
| Dorigallu .. .. .. .. | 185·78 | 671 6 0 | .. | .. | .. | 185 13 0 | .. | 117 5 0 | |
| Morathad .. .. .. .. | 30·71 | 116 9 0 | .. | .. | .. | 26 10 0 | .. | 11 6 0 | 1317 fasli. |
| Patnam .. .. .. .. | 433·1 | 2,296 9 0 | .. | .. | .. | 131 0 0 | 43 9 0 | 124 6 0 | |
| Total .. | .. | 3,084 8 0 | .. | .. | .. | 343 7 0 | 43 9 0 | .. | |

## Dorigallu.

| Increase of revenue under dry lands. | | | | Increase of revenue under wet lands. | | | |
|---|---|---|---|---|---|---|---|
| | RS. A. P. | ACS. | RS. | | RS A. P. | ACS. | RS. |
| A. 8—5 class— | | | | | | | |
| Dry rate in III group .. .. .. | 0 4 0 | | | Wet in II group .. .. .. .. | 2 8 0 | | |
| Wet rate in I do. .. .. .. | 3 0 0 | 1,085 | 2,984 | Do. I do. .. .. .. .. | 3 0 0 | 14 | 7 |
| | 2 12 0 | | | | 0 8 0 | | |
| B. 8—3 class— | | | | | | | |
| Dry rate in III group .. .. .. | 0 8 0 | | | Wet in II group .. .. .. .. | 3 8 0 | | |
| Wet rate in I do, .. .. .. | 4 0 0 | 485 | 1,698 | Do. I do. .. .. .. .. | 4 0 0 | 23 | 12 |
| | 3 8 0 | | | | 0 8 0 | | |
| C. 7—5 class— | | | | | | | |
| Dry rate in III group .. .. .. | 0 6 0 | | | Wet in II group .. .. .. .. | 3 8 0 | | |
| Wet rate in I do. .. .. .. | 3 8 0 | 78 | 244 | Do. I do. .. .. .. .. | 3 0 0 | 43 | 22 |
| | 3 2 0 | | | | 0 8 0 | | |
| D. 7—4 class— | | | | | | | |
| Dry rate in III group .. .. .. | 0 8 0 | | | Wet in II group .. .. .. .. | 3 8 0 | | |
| Wet rate in I do. .. .. .. | 4 0 0 | 347 | 1,215 | Do. I do. .. .. .. .. | 4 0 0 | 38 | 19 |
| | 3 8 0 | | | | 0 8 0 | | |
| E. 7—3 class— | | | | | | | |
| Dry rate in III group .. .. .. | 0 12 0 | | | Wet in II group .. .. .. .. | 4 0 0 | | |
| Wet rate in I do. .. .. .. | 5 0 0 | 216 | 918 | Do. I do. .. .. .. .. | 5 0 0 | 70 | 70 |
| | 4 4 0 | | | | 1 0 0 | | |
| F. 7—2 class— | | | | | | | |
| Dry rate in III group .. .. .. | 1 0 0 | | | Wet in II group .. .. .. .. | 5 0 0 | | |
| Wet rate in I do. .. .. .. | 6 0 0 | 111 | 555 | Do. I do. .. .. .. .. | 6 0 0 | 29 | 29 |
| | 5 0 0 | | | | 1 0 0 | | |
| G. 3—4 class— | | | | | | | |
| Dry rate in III group .. .. .. | 1 0 0 | | | Wet in II group .. .. .. .. | *Nil.* | .. | .. |
| Wet rate in I do. .. .. .. | 5 0 0 | 260 | 1,040 | Do. I do. .. .. .. .. | *Nil.* | .. | .. |
| | 4 0 0 | | | Total .. | .. | 217 | 159 |
| | | 2,582 | 8,654 | | | | |
| | | 217 | 159 | | | | |
| | | 2,799 | 8,813 | | | | |
| | Inam wet .. | 24 | *Nil.* | | | | |
| Total .. | | 2,823 | 8,813 | | | | |

## Morathad.

| Increase of revenue under dry lands. | RS. A. P. | ACS. | RS. | Increase of revenue under wet lands. | RS. A. P. | ACS. | RS. |
|---|---|---|---|---|---|---|---|
| 8—5 class— | | | | | | | |
| Dry III group .. .. .. .. | 0 4 0 | | | Wet II group .. .. .. .. | 2 8 0 | | |
| Wet I do. .. .. .. .. | 3 0 0 | | | Wet I do. .. .. .. .. | 3 0 0 | | |
| | 2 12 0 | 1,411 | 3,880 | | 0 8 0 | 19 | 10 |
| 8—3 class— | | | | | | | |
| Dry III group .. .. .. .. | 0 8 0 | | | .... | .. | .. | .. |
| Wet I do. .. .. .. .. | 4 0 0 | | | .... | .. | .. | .. |
| | 3 8 0 | 73 | 256 | | .. | .. | .. |
| 7—4 class— | | | | | | | |
| Dry III group .. .. .. .. | 0 8 0 | | | .... | .. | .. | .. |
| Wet I do. .. .. .. .. | 4 0 0 | | | .... | .. | .. | .. |
| | 3 8 0 | 563 | 1,970 | | .. | .. | .. |
| 7—3 class— | | | | | | | |
| Dry III group .. .. .. .. | 0 12 0 | | | .... | .. | .. | .. |
| Wet I do. .. .. .. | 5 0 0 | | | .... | .. | .. | .. |
| | 4 4 0 | 30 | 128 | | .. | .. | .. |
| 7—2 class— | | | | | | | |
| Dry III group .. .. .. .. | 1 0 0 | | | .... | .. | .. | .. |
| Wet I do. .. .. .. .. | 6 0 0 | | | .... | .. | .. | .. |
| | 5 0 0 | 134 | 670 | | .. | .. | .. |
| 7—1 class— | | | | | | | |
| Dry III group .. .. .. .. | 1 4 0 | | | Wet II group .. .. .. .. | 6 0 0 | | |
| Wet I do.. .. .. .. .. | 7 0 0 | | | Wet I do. .. .. .. .. | 7 0 0 | | |
| | 5 12 0 | 7 | 40 | | 1 0 0 | 11 | 11 |
| | | 2,218 | 6,944 | | | 30 | 21 |
| | | 30 | 21 | | | | |
| | | 2,248 | 6,965 | Total, Morathad .. | 6,965 0 0 | | |
| | Inam wet .. | 3 | *Nil.* | ,, Dorigallu .. | 8,803 0 0 | | |
| Total .. | | 2,251 | 6,965 | Total .. | 15,768 0 0 | | |

*Resolution—Mis. No.* 849, *dated* 11*th March* 1909.

The letter from the Collector of Cuddapah read above will be submitted to Government with reference to their endorsement No. 946-C-08-1, dated 16th June 1908.

2. The Dorigallu project was originally designed to irrigate 9,075 acres in four villages, but the irrigable area under the project, as revised by the Superintending Engineer, is only 5,000 acres. As no tracings from the village plans localizing this area were furnished by the Superintending Engineer, the Collector has taken into account the 5,074 acres affected by the project in the villages of Dorigallu and Morathad which will have to be served by the project before the other two villages are reached.

3. The irrigable area consists of Government and Inam lands as shown below :—

| | Wet. | Dry. |
|---|---|---|
| | ACS. | ACS. |
| Government ... ... ... ... ... | 247 | 4,800 |
| Inam ... ... ... ... ... ... | 27 | ... |

The Collector considers that after the completion of the project, first-class wet rates may be levied under it and calculates that Rs. 15,588 in the shape of water-rate and Rs. 180 in the shape of enhanced wet assessment will be derivable from the 4,800 acres of dry and 247 acres of Government wet lands, respectively. The 27 acres of Inam wet lands will have to be allowed water free of charge. The total income derivable will thus be Rs. 15,768, but the Collector states that, excluding the amount of remission which may have to be paid, the income may be taken at Rs. 15,000 in round figures. For purposes of an estimate this figure may, the Board thinks, be adopted as the gross income from the 5,000 acres under the project. The net revenue will then come to Rs. 10,500 as shown below :—

| | RS. |
|---|---|
| Gross revenue ... ... ... ... ... ... ... ... | 15,000 |
| *Deduct*— | |
| (1) Working expenses at 12 annas per acre on the entire area of 5,000 acres ... ... ... ... ... ... ... | 3,750 |
| (2) Collection charges at 5 per cent. on the gross revenue of Rupees 15,000 ... ... ... ... ... ... ... ... | 750 |
| Total deductions ... | 4,500 |
| Net increase ... ... ... ... ... ... ... ... | 10,500 |

4. Taking the capital outlay at the lower figure given by the Superintending Engineer, viz., Rs. 16,62,000, the return from the project will be only 0·6 per cent. The capital cost of the work being Rs. 16,62,000÷5,000 acres or Rs. 332 per acre, the equation for *m* will be 20 *r* +m x= Rs. 332, *r* being in this case Rs. 10,500÷5,000 acres or 2·1 ; *mx* will be equal to 290, x being 18 (*vide* Appendix II (*b*) to Board's Proceedings, Mis. No. 2150, dated 7th May 1908, recorded in G.O., No. 1548, Revenue, dated 1st June 1908), *M* or the index of extra expenditure necessary to protect the tract against famine will be 16·1. This shows that the cost of the project is excessive even for a protective work. The Collector further doubts whether in the absence of leaf manure so large an area can be brought under irrigation by the ryots. On the whole the project does not appear to be one whose execution even as a protective work can be recommended.

(True Extract.)

L. D. SWAMIKANNU,
*Secretary.*

To the Secretary to Government, Revenue Department,
with tracings, estimates and other papers.

ENCLOSURES.

Report to accompany the estimate for constructing a dam across the Madduleru River near the village of Dorigallu, Kadiri taluk, Cuddapah district.

RS.

Amount of estimate ... ... ... ... ... ... 11,54,000

1. *History.*—The first proposals for constructing a dam across the Madduleru river was the outcome of a suggestion by Mr. J. N. Atkinson, when Sub-Collector, Madanapalle, in his No. 3668, dated 24th August 1892; in which he proposed damming the river at a point ¼ of a mile above the hamlet of Nakkalapalle in the Dorigallu village limits. Subsequent investigations were carried out by conductor Ulyett, and a scheme was drawn up by him for constructing an earthen dam to store water 50 feet above the bed of the river, forming a reservoir capable of irrigating 3,000 acres. On further investigation he proposed a dam to store 60 feet of water, and a reservoir capable of irrigating 5,000 acres. Owing to the rocky and stony nature of the country, a core wall down the centre of the bund was considered necessary; and the cost of the reservoirs in comparison with the area irrigated was almost prohibitive. The difficulty of procuring good earth suitable for the bund also leads to the present proposals; which are—

(1) Constructing a combined masonry and earthen dam across the Muddaleru river at the site shown in Survey Plan No. 1. The site selected is 3 furlongs higher up the river than the site selected by conductor Ulyett. At this place there is a barrier of rock exposed right across the river.

(2) The dam will be of sufficient height to store water to a depth of 70′ above river bed; and will form a reservoir capable of irrigating 11,000 acres of rice.

2. *Source of supply.*—The Madduleru river at the site of the dam drains an area of 500 square miles of fairly hilly catchment. Plan of catchment basin is enclosed; the proposed site of dam is about two miles south of Dorigallu village. Latitude 14° 24″ N., Longitude 78° 7″ E. For the purpose of estimating the supply of water available, the average rainfall for each month in the year at the Taluk head-quarters, Kadiri, is taken. They are as follows:—

| January. | February. | March. | April. | May. | June. | July. | August. | September. | October. | November. | December. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0·04 | 0·06 | 0·31 | 0·49 | 2·15 | 2·37 | 2·45 | 4·29 | 6·17 | 5·48 | 2·34 | 0·44 |

Neglecting the rainfall from January to May as having no appreciable run-off, and dividing the remaining months into two periods; the south-west and north-east monsoons, *i.e.*, June to September south-west monsoon, October to December north-east monsoon, and taking 15 per cent. of the south-west and 20 per cent. of the north-east as the run-off that might be expected, (*vide* this office No. 4602, * dated 11th August 1905, in which detail calculations are given) we get.—

* Communicated to the Chief Engineer with Superintending Engineer's No. 4723 I., dated 15th December 1905.

South-west monsoon 15 per cent. of 14·28 = 2·22″
North-east „ 20 per cent. of 8·26 = 1·64″
Catchment = 500 sq. miles.
Supply available.
South-west monsoon = 2,600 millions cubic feet.
North-east „ = 1,900 „ „

3. *Dam.*—The site of the dam is shown in survey plan No. 1 and Plan A; it will form a reservoir storing water to contour 370·00 and having a capacity of 1,174 millions cubic feet; taking 200,000 cubic feet as a sufficient storage for one acre of rice (*vide* this office No. 4602, dated 11th August 1905), the reservoir will be capable of irrigating 5,800 acres with one filling and 11,600 acres with two fillings; to say nothing of a supply left over for a second crop. From paragraph 2 it will be seen that the supply available is more than sufficient to give the reservoir two fillings.

Owing to the difficulty of procuring good earth for forming the bund, it is proposed to construct the dam partly of earth and partly of masonry; this has been found to be the most economical method. Plan No. A shows the plan and site of the dam; Plan No. B shows the sections of the various parts. The selected earth will have to be brought from a distance of one mile, and for which a light tramway may be necessary. The earth at site is a poor, red, sandy earth largely mixed with stones. The earthen bund will have a core wall founded on rock, down its centre, joining, and bonded into the wings of the masonry dam. The masonry dam will be

built of rubble in surki mortar, well bonded horizontally and vertically; as granitoid gneiss is obtained within a mile of the site, it will be used in preference to the quartzite which forms the bed of the river. Plan No. D shows the depth at which rock is met with along the site selected by Conductor, Ulyett; the present proposed site is three furlongs higher up, where there is a barrier of rock exposed right across the river. Specimens of the rock sent to the Director, Geological Survey of India, are described by him as being a "schistose quartzite intruded into by a basic rock, which is very fine grained and contains much iron pyrites."

The rock is hard and suitable for forming a good foundation. These quartzites form the extreme south-western boundary of what is known as the Cuddapah formation and directly overlie the older gneissic bed.

In Plan No. C a diagram of the stresses in the dam is shown for a depth of 54 feet from M.W.L. The dam is so designed that should a feisure extend to $\frac{1}{4}$ its width, through inferior workmanship, the resultant stresses would still tend to close the feisure. The dam is drawn with an arc of a circle for the rear face for convenience; in actual construction the rear face will be a series of "batters".

4. *Weir and M.F.D.*—The maximum recorded rainfall at Kadiri is 6·79″ in 24 hours on 6th November 1903.

Using formula C M $\frac{3}{4}$ (*vide* this office No. 4602, dated 11th August 1905) where $c$ = 54 × 6·79 = 366·60, say 370.

M = 500.

The maximum flood discharge amounts to 37,850 cusecs, say 40,000 cusecs = run off of 3″ in 24 hours from catchment area.

Taking a head of 5: Discharge per 1′ run of weir = 3·3 × $5^{\frac{3}{2}}$ = 39·2 say 40 cusecs.

Length of weir required = 1,000′ considering the heavy floods of November 1903, the considerable damage caused to irrigation works, the length 1000′ is none too small.

Plan and sections of the weir are shown in Plan No. B. The curve given to the crest corresponds to the path of the falling water; which will flow down the face of the dam into a water cushion below. The crest of the weir will have a cutstone cap of trap if available and will be bonded vertically.

5. *Irrigation.*—The irrigation will be carried out by three channels as noted below:—

Channels on the right bank of Madduleru—

(1) Channel starting at R.L. 330·00 to irrigate 1,000 acres.

(2) Channel starting at R.L. 310 to irrigate 5,000 acres.

Channels on left bank—

(3) Channel starting at R.L 305·00 to irrigate 5,000 acres.

(4) Sluice at R.L. 319·00 to irrigate 100 acres of Nakkalapalle lands now irrigated direct from the river. Survey plans I, III, IV and tracing V show the general direction of the right bank channels and area commanded which is hatched green. Survey Plans I, II and V show the general direction of the left bank channel and area commanded. In the original project, it was proposed to run the left bank channel into the Dorigallu tank and take off another channel below the tank which would give a fall of over 20′ and loss of area commanded. It is now proposed to take the channel above the tank; to abandon the tank and cultivate its bed. The channels form only a subsidiary part of the estimate of the dam and the lump sum Rs. 30,000 allotted for the channels and their branches is ample; at Rs. 2 an acre the amount would come to Rs. 22,000.

6. *Sluices.*—Owing to the depth of water an equilibrium sluice of some nature will be necessary. Plan No. C shows a general design for the sluices. The design is a modification of the equilibrium sluice used at the Periyár dam; and consists of a cylinder covered at the top and open below, bolted to a cast iron bed plate; slit openings 6″ wide and 2′ deep are cut around the cylinder giving an area sufficient to pass the required discharge. The sluice is closed by another cylinder open at both ends fitting over the fixed cylinder. As the water pressure will be the same all round the outer cylinder, only the weight of the cylinder + the pressure on its rim and handles will have to be raised. This total comes to a little over 2 tons. A 3-ton winch and $\frac{1}{2}$ inch crane chain is provided. The side walls of the sluice will have bond stones at intervals through which the chain will pass; just above the sluice a wrought iron pipe will be built into two bond stones of a height above the sluice to prevent the cover being completely raised off the inner cylinder, and as a guide to the chain.

7. *Financial prospects.*—I enclose letter No. R.C. 3645-Rev., dated 6th October 1905, from the Sub-Collector, Madanapalle, Mr. F. A. Coleridge, who has treated the subject in a most exhaustive manner; and I have nothing to add. Even with the very safe and cautions forecats made by him, the project will give a return of 4½ per cent.

The construction of the dam will present no difficulty; good lime and stone (granitoid gniess) are obtained within a mile of the proposed site. During the dry months there is always a small quantity of water flowing down the river; not however sufficient to cause any difficulty to the foundations being laid and enough for the supply necessary for the work, *i.e.*, during the months from March to June the river is a streamlet trickling down the rocks. As the work proceeds, the ordinary flow will be passed through the sluice vents; extraordinary floods must pass over the dam till the weir level is reached. Although the reservoir will be primarily constructed for irrigation, it is quite possible that in the near future industries may be developed, owing to the considerable amount of water power available. By a slight modification, the sluices might be made inward flow turbiness capable of developing many hundreds of horse-power.

The village of Nakkalapalle itself was once noted for the manufacture of glass bangles, the trade has now died out owing, it is reported, to the want of fuel.

The Cuddapah district is rich in iron ore and lead of a very fine quality is found. It only requires heat to develop these industries. The site of the dam is 6 miles from Mudigubba station on the Villupuram-Guntakal line.

Total cost of project = Rs. 9,00,000.

Total cost per acre = Rs. 82.

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*Letter*—from F. A. COLERIDGE, Esq., I.C.S., Acting Sub-Collector, Madanapalle.
*To*—the Executive Engineer, Cuddapah Division.
*Dated*—the 30th September 1905.
*No.*—Ref. on C. 3645-Rev.

I have the honour to reply to your letter No. 5177, dated 11th September 1905, relating to the Dorigallu project.

2. The figures for land acquisition are as follows :—

(*a*) *Land in holdings to be paid for as being submerged by the formation of the tank.*—Three wet fields and 43 dry fields. Wet land in the neighbourhood sold for Rs. 30 an acre and this figure can be adopted. Dry lands sell for 20 times dry assessment. Total compensation Rs. 1,526. Statement A shows the fields and areas and values to be submerged. Many of these are Government lands not in occupation and no compensation is required. I am addressing Collector to have all such lands put on the prohibited list.

(*b*) *Land required for the distributary channels.*—Taking the width of the channel as 75 links and giving compensation only for the lands which are in holding. The compensation required will be —

| | RS. | A. | P. |
|---|---|---|---|
| Dorigallu ... ... ... ... ... ... ... ... | 466 | 8 | 0 |
| Morathad ... ... ... ... ... ... ... | 49 | 4 | 0 |
| Bandlapalli ... ... ... ... ... ... ... | 90 | 0 | 0 |
| Kodavandlapalli ... ... ... ... ... ... ... | 11 | 0 | 0 |
| Total ... | 616 | 12 | 0 |

This may be taken as the outside figure. Statement B shows the lands and their values. It is to be noted that Bandlapalle is a shrotriem and has not been surveyed and numbered. I have taken Rs. 5 per acre as the value of the lands for the 3 miles through this village as they are all dry fields with no wells and no garden lands.

3. Turning to the project itself it would seem from plan I that there is only one sluice channel west of the river and if the channel is dug as shown in blue on the plan the lands west of the channel, viz., 1,115, 992, 993, 995, 985, 1,001, 1,006 and so on which are all wet lands under Nakkalapalle channel will not be irrigable as the river being bunded up, there will presumably be no water for the Nakkalapalle channel. These lands would have to be transferred to dry and compensation paid. In the old proposal two sluice channels were provided one of

which was for the irrigation of these fields—so I believe—and the other for the fields lower down. I think it will be very desirable to, if possible, construct an extra sluice channel for the use of these fields so as to save compensation for conversion to dry. If the latter has to be done then Rs. 75 an acre may be taken as a value.

4. The Sub-Overseer Francis sent to show the course of the channel could not give the exact course, he said, of the south channel. However it is evident it must go through 928, 215, 216 and 217 and all these and the adjoining fields are waste and no compensation is required.

5. Statement C gives the fields that are irrigable by the project and the areas of the villages are as below :—

| | ACS. |
|---|---|
| Dorigallu ... ... ... ... ... ... ... ... | 2,823 |
| Morathad ... ... ... ... ... ... ... ... | 2,251 |
| Bandlapalli ... ... ... ... ... ... ... ... | 1,339 |
| Kodavandlapalle ... ... ... ... ... ... ... | 2,662 |
| Total ... | 9,075 |

This is the area up to the course marked for the channels in the plans. If, however, the northern lower channel is extended for one-fourth mile in Kodavandlapalle 1,000 more acres are irrigable in this village, bringing the total to 10,075 acres.

6. The capacity of the tank is shown as 1,174 millions cubic feet and this you inform me will irrigate 6,000 acres at one filling. As you have pointed out and as I know from visits to the river at all times of the year which is never without water, the tank may be relied on to fill twice regularly. From the geological formation above as two strata lie above each other and form a pocket into which vast stores of water collect, there is certain to be a large percolation into the tank long after the stream has ceased to flow as it is this stored-up water that gives the river its supply in the hot months. Allowing for this and for the tank filling twice there should be water available for 10,000 acres at least. This at Rs. 4 an acre would give Rupees 40,000 a year and if the cost is 10 lakhs as estimated, the return would be 4 per cent. It might be possible to reduce the cost to 9 lakhs, I venture to suggest, as the rates allowed are decidedly generous especially for earth work. If this were done the return would be $4\frac{1}{2}$ per cent.

7. I have taken the area irrigable as only 10,000 acres, not that this is all the land that water could flow to, for, by continuing the channels into Kodavandlapalle a further area is obtainable, but because the ryots would be unwilling to venture for many years to come to take water so far down for fear lest the tank should not always fill sufficiently a second time to give them their water at the right time and also because the water would take long to reach these lowest lands and might entirely fail to do so if the tank did not get a full supply.

8. I have also not taken into account the fact that the lands lying near the tank will always raise two crops and there will certainly be second crop on 1,000 acres and this may be set to the credit of the project at Rs. 2 an acre giving for second crop Rs. 2,000 or a total revenue of Rs. 42,000.

9. Another small item to be considered is that at present as can be seen from column 3 of statement C there are a very large number of lands not in holding. These could be sold by public auction as also the bed of Dorigallu tank whose ayakat will be irrigated by the project and the proceeds credited towards paying the compensation for lands acquired. Further these lands are never likely to yield any revenue as dry fields as there are vast areas of dry lands available already, but these lands when irrigable will be at once of value and there will be the assessment on them to be taken into account. The lands of Bayyappa Reddi kalva, 24 acres, Nakkalapalle kalva, 81 acres, Kotha kalva, 15 acres, would be transferred to the project and Rs. 101 ready money allowance for the upkeep would be annually saved.

10. Taking everything into account if the cost of the project is 9 lakhs there should be a return of at least $4\frac{1}{2}$ per cent. and as I have shown, a prospect of more under fasaljasti and assessment on lands not at present in the holding.

The tables A, B, C have been carefully prepared on the ground with the village officers by carefully following the channels as shown in your plans and may therefore be accepted as accurate.

11. Turning from the financial aspects of the case which are distinctly favourable when based on the estimate of 9 or 10 lakhs I must point out the great protective value of the project. This corner of the divisions is the most liable of any to be famine-affected and the first to need

remission and famine assistance. By protecting it there will be a large saving in remissions and famine outlay and it will also supply large stores of food for the surrounding parts both in this division and the adjoining taluks of Anantapur, all of which are sadly liable to famine. It would also afford annual labour to the surrounding labouring classes for weeding and transplanting and harvesting.

12. As this project and the Itodu project are the only two that can possibly benefit the Kadiri taluk and help to render it less famine-stricken and as this one promises well financially I am of opinion that it should be pushed on and brought to the notice of Government as early as possible.

13. I return the plans herewith with my three statements A, B and C.

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## XXXII

### Note by the Chief Engineer for Irrigation.

The papers read above relate to the formation of a reservoir across the Muddaleru near Dorigallu village in Kadiri taluk, Cuddapah district.

1. The project was first proposed in 1892 by Mr. J. N. Atkinson, the then Sub-Collector of the district. A preliminary investigation of the scheme was made by Sub-Conductor Ulyett in 1897, while he was in charge of the Tank Restoration Scheme Party, organised in that district. The detailed investigation was conducted by Mr. Lacey (Executive Engineer) and plans and estimates amounting to Rupees 9,00,000 for works or Rs. 11,54,000 including direct and indirect charges were submitted with the Superintending Engineer's letter No. 258, dated 20th January 1906.

2. *Scope of project.*—The proposal was to form a reservoir by constructing a combined masonry and earthen dam across the Muddaleru, a tributary of the Chitravati river, to have a capacity of about 1,174 millions cubic feet to command nearly 11,000 acres of wet crop cultivation with two fillings.

3. *Source of supply.*—The supply expected from 500 square miles of the drainage area of the Muddaleru above the site of the proposed dam was estimated at 4,500 millions cubic feet representing a run-off of 3·87" in 24 hours over the catchment, the average annual rainfall and the maximum recorded fall in 24 hours at Kadiri, a rain recording station within the catchment, being 25·59 and 6·79 inches, respectively.

4. *Surplus arrangements.*—The maximum flood discharge from the drainage area of 500 square miles was calculated at 40,000 cusecs by using Dicken's formula $D = CM^{\frac{3}{4}}$ with co-efficient 370 (or say 600 in Ryves' formula $D = CM^{\frac{2}{3}}$). This represents a run-off of 3 inches in 24 hours from the catchment area. A masonry weir 1,000 feet long was provided at the left flank to dispose of the surplus with a depth of 5 feet on crest.

5. *Costs.*—The estimate provided for—

| | RS. |
|---|---|
| (1) Constructing a combined masonry and earthen dam including surplus weir ... ... ... ... ... ... ... | 8,35,000 |
| (2) Constructing four sluices in the dam for distribution of supply ... ... ... ... ... ... ... | 15,000 |
| (3) Excavating channels from sluices ... ... ... ... | 30,000 |
| (4) Land compensation ... ... ... ... ... ... | 2,150 |
| (5) Unforeseen works ... ... ... ... ... ... | 17,850 |
| Total for works ... | 9,00,000 |

*Dam.*—Owing to the difficulty of procuring good earth for forming the bund it was proposed to construct it partly of masonry and partly of earth. The masonry portion of the dam was proposed to be 1,250 feet long and about 70 feet high above

deep bed at the river-crossing with its crest at M.W.L. + 375·00, connected by earthen dams of 1,500 feet and 2,100 feet long at the right and left ends, respectively. The earthen dam was proposed to have a margin of 10 feet above M.W.L. with a top width of 15 feet, front slope $2\frac{1}{2}$ to 1, and rear slope 3 to 1.

6. As sufficient information was not furnished as to the suitability of the general arrangements, adequacy of the estimates, surplus work, distribution, etc., the papers were returned to the Superintending Engineer with this Office Memorandum No. 1258, dated 6th April 1906, for reconsideration and resubmission in a more complete form.

7. With his letter No. 3181, dated 2nd May 1908, the Superintending Engineer, III Circle, submits a report on the feasibility of the Dorigallu project for final orders. He reports—

(1) That the capacity originally calculated was incorrect and that on taking revised contours it is observed that the capacity at the proposed F.T.L. + 370·00 amounts to only 696·34 millions cubic feet against 1,174 millions cubic feet calculated originally and that in order to obtain a capacity of 1,000 millions cubic feet the F.T.L. should be raised to + 380·00 and that the F.T.L. and M.W.L. should be made the same by fixing self-acting shutters 5 feet high of the pattern now in use in lake Fife.

(2) That the rainfall statistics at Kadiri conclusively show that a reservoir having a capacity of 1,000 millions cubic feet could not as a rule be expected to fill more than once in a year as it is seen from the nature of the rainfall distribution that in many years, the second filling would have followed so hard on the first that it would have surprised a full reservoir and all gone to waste.

(3) That it is not possible to depend on more than 5,000 acres of wet crop with reservoir of 1,000 millions cubic feet capacity.

(4) That the cost of the project as proposed by Mr. Lacey had been considerably underestimated and the capacity of the reservoir overestimated and that proper estimates of Mr. Lacey's proposals and the one with modification now suggested by the Superintending Engineer would come to Rs. 16,62,000 and Rs. 18,65,000, respectively.

(5) That the money now being spent on the Maidkur and Chepad channels and that proposed to be spent hereafter on Velgode project is a much better investment and seems to be giving the Cuddapah district all the encouragement which it requires now. The Superintending Engineer therefore recommends that the Dorigallu project may lie over for the present as there does not seem to exist in the district any necessity that would warrant the outlay of such a large sum yielding a very poor return.

8. *Financial forecast.*—From the financial forecast of the project received from the Collector through the Board of Revenue it would appear that the Collector agrees with the Superintending Engineer in thinking that it is not safe to assume that the supply will be sufficient to support on the average more than one wet crop every year and he estimates the probable increase of revenue at Rs. 15,000. Deducting working expenses at As. 12 per acre on 5,000 acres the net increase of revenue expected amounts to Rs. 15,000 — 3,750 = Rs. 11,250. This represents a return of 0·68 per cent. on the proposed outlay of Rs. 16,62,000 (lower figure) or 0·60 per cent. on Rs. 18,65,000 (higher figure) reported by the Superintending Engineer.

9. The value of M or the index of the price to be paid for protecting the tract in question against famine, works out to 16 to 18 which is far in excess of the maximum limit of 3 fixed by the Irrigation Commission. The Collector also doubts whether in the absence of leaf manure the ryots could bring such a large area under wet cultivation. Considering this and the high value of M which is, say, more than five times the limiting value, the project is not feasible as a protective work, nor will it be suitable for famine-relief as the main portion consists of a masonry dam. It is, therefore, recommended that the project be finally abandoned.

C. A. Smith,
*Chief Engineer for Irrigation.*

4*th June* 1909.

**Order—No. 252 I., dated 15th June 1909.**

The recommendation of the Chief Engineer for Irrigation to abandon finally the Dorigallu project, Cuddapah district, is approved.

(True Extract.)

C. A. SMITH,
*Joint Secy. to Govt., P.W.D.,*
*Irrigation Branch.*

To the Chief Engineer for Irrigation.
,, Superintending Engineer, III Circle, with plans and estimate.
,, Examiner, Public Works Accounts.
,, Revenue Department.

# Government of Madras.

PUBLIC WORKS DEPARTMENT.

IRRIGATION.
ACCOUNT.

| | | |
|---|---|---|
| *Recd.* | 1909. | *Enclosures* |
| *Regd.* | | *Spare copies* |

## G.O., Nos. 253, 254 I., 15th June 1909.

**Cattle ramp at the Ellore Canal, Godavari Western Division**

Forwarding to the Government of India a copy of the Proceedings sanctioning the estimate of Rs. 2,214 for constructing a —.

GOVERNMENT OF MADRAS.

PUBLIC WORKS DEPARTMENT.

**Irrigation.**
**Account.**

Read—the following papers:—

I

*Letter*—from C. W. Wood, Esq., Superintending Engineer, I Circle.
*To*—the Chief Engineer for Irrigation.
*Dated*—Vizagapatam, the 29th April 1909.
*No.*—432 W.

I have the honour to forward herewith for favour of sanction an estimate amounting to Rs. 1,800 for constructing a cattle ramp at 42 miles 8 chains of Ellore canal.

The necessity for the work is explained in the report accompanying the estimate.

Enclosure.

*Report to accompany the estimate for constructing a cattle ramp at 42 miles 8 chains of Ellore canal.*

| | RS. |
|---|---|
| Amount of estimate ... ... ... ... ... ... ... | 1,800 |

The crossing at this place is at present in a bad condition, on account of floods due to breaches to Ellore canal. Early sanction to the estimate is requested.

28*th March* 1909.

J. M. Lacey,
*Executive Engineer.*

II

**Note by the Chief Engineer for Irrigation.**

The estimate amounting to Rs. 1,800 for constructing a cattle ramp at 42 miles 8 chains of Ellore canal submitted by the Superintending Engineer, I Circle, is recommended for sanction.

2. The width allowed for the ramp is unusual and if there are special reasons for it they should have been stated in the report. It is suggested that a less width with revetted sides might be more satisfactory, but this is left to the Superintending Engineer to decide during construction.

10*th June* 1909.

C. A. Smith,
*Chief Engineer for Irrigation.*

**Order—No. 253 I., dated 15th June 1909.**

The following estimate is sanctioned :—

Imperial.
Capital expenditure not charged to Revenue.
49. Irrigation.
Gódávari Delta System.
Western Division.
Open Capital Account.
I. Works.
2. Main canals and branches.
O. Miscellaneous.
Unremunerative work.

Constructing a cattle ramp at 42 miles 8 chains of Ellore canal.

Estimate—

| | | RS. |
|---|---|---|
| I Works | ... | 1,800 |
| II Establishment | ... | 414 |
| | Total ... | 2,214 |

2. This sanction is registered as No. 39 I. of 1909–1910 and will expire on 31st March 1910.

3. The attention of the Superintending Engineer, I Circle, is drawn to paragraph 2 of the note by the Chief Engineer for Irrigation.

4. Ordered that a copy of these proceedings be forwarded to the Government of India for information.

[Here enter No. 254 I., dated 15th June 1909.]

(True Extract.)

C. A. SMITH,
*Joint Secy. to Govt., P.W.D.,*
*Irrigation Branch.*

To the Chief Engineer for Irrigation.
,, Superintending Engineer, I Circle, with plans and estimate.
,, Examiner, Public Works Accounts.

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**Endorsement—No. 254 I., dated 15th June 1909.**

Forwarded.

(By Order.)

C. A. SMITH,
*Joint Secy. to Govt., P.W.D.,*
*Irrigation Branch.*

# Government of Madras.

## PUBLIC WORKS DEPARTMENT.

IRRIGATION.
ACCOUNT.

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## G.O., No. 255 I., 15th June 1909.

**Overseer's quarters at the Kanigiri Reservoir, Nellore Division**

Approving, with remarks, the estimate of Rs. 150 for the construction of a compound wall round the —.

GOVERNMENT OF MADRAS.

PUBLIC WORKS DEPARTMENT.

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**Irrigation.**
**Account.**

READ—the following papers :—

I

*Letter*—from S. B. MURRAY, Esq., A.M.I.C.E., Superintending Engineer, II Circle.
*To*—the Chief Engineer for Irrigation.
*Dated*—Bezwada, the 4th May 1909.
*No.*—45 I.

I have the honour to forward herewith for the sanction of Government an estimate, amounting to Rs. 120, for constructing a compound wall round the Overseer's quarters at the Kanigiri reservoir, Nellore district.

2. A data statement of rent is enclosed, from which it will be seen that the monthly rental comes to Rs. 7·4 against Rs. 8·33 shown in G.O., No. 268 I., dated 8th June 1907. The difference is due to the cost of maintenance and repairs being taken at 2 per cent.—see Chief Engineer's No. 5810 C., dated 27th November 1907. The Overseer will, however, be charged only Rs. 6 with reference to Public Works Code, paragraph 922.

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ENCLOSURE.

*Report to accompany the estimate for constructing a compound wall round the Overseer's quarters at the Kanigiri Reservoir.*

| | RS. |
|---|---|
| Amount of estimate ... ... ... ... ... ... ... | 120 |

The estimate for the Overseer's quarters was sanctioned in G.O., No. 268 I., dated 8th June 1907, and the work was completed at a cost of Rs. 1,492. As the quarters have been built in a very public situation, it is desirable that they should be given some privacy. To secure this, a compound wall, as shown in the plan accompanying the estimate, is proposed.

There are about four units of stone available from the old quarters, and a quantity of bricks, sufficient for the coping. These will be used, and consequently only labour charges, plastering, pointing, etc., have been provided for.

Early sanction is recommended.

R. N. AROGYASWAMI MUDALIYAR,
*Executive Engineer, Nellore Division.*

## II

### Note by the Chief Engineer for Irrigation.

The proposal made in the paper read above to construct a compound wall round the Overseer's quarters at the Kanigiri reservoir, Penner River Canals system, may be approved, and the estimate for the work returned to the Superintending Engineer to be sanctioned by him under the head "42. Extensions and Improvements," as the proposed expenditure is below Rs. 1,000.

2. The amount of the estimate has been increased in this office from Rs. 120 to Rs. 150 owing to the rate for the rough stone in mud having been raised from Rupees 5-3-0 to Rs. 6-8-0, the former rate being considered low.

1?th *June* 1909.

C. A. SMITH,
*Chief Engineer.*

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**Order—No. 255 I., dated 15th June 1909.**

The recommendation of the Chief Engineer for Irrigation is approved and the estimate for the work will be returned to the Superintending Engineer for disposal.

(True Extract.)

C. A. SMITH,
*Joint Secy. to Govt., P.W.D.,*
*Irrigation Branch.*

To the Chief Engineer for Irrigation.
,, Superintending Engineer, II Circle, with plan and estimate.
,, the Examiner, Public Works Accounts.

# Government of Madras.

## PUBLIC WORKS DEPARTMENT.

IRRIGATION.

| | | |
|---|---|---|
| *Recd.* | 1909. | *Enclosures* |
| *Regd.* | | *Spare copies* |

## G.O., No. 256 I., 15th June 1909.

**Cauvery Reservoir Project.**

Communicating to the Superintending Engineer on Special duty, for information and guidance, letter from the Government of India forwarding copy of a note by the Inspector-General of Irrigation regarding the investigation of the —, and stating that the question of the enhancement of water-rate for rice on lands opened out for irrigation will be dealt with in the Revenue Department.

GOVERNMENT OF MADRAS.

# PUBLIC WORKS DEPARTMENT.

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## Irrigation.

READ—the following papers :—

I

**G.O., Nos. 461, 462 I., dated 10th December 1908.**

ABSTRACT.—Forwarding to the Government of India copy of Proceedings approving the recommendation of the Chief Engineer for Irrigation to continue the detailed investigation of the Cauvery Reservoir Project.

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II

From the Inspector-General of Irrigation, dated 6th April 1909, No. 40 I.G.

To the Superintending Engineer on Special duty, No. 4-O., dated 20th April 1909.

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III

*Letter*—from H. M. WILLMOTT, Esq., Under Secretary to the Government of India, Public Works Department (Civil Works—Irrigation).
*To*—the Joint Secretary to the Government of Madras, Public Works Department (Irrigation Branch).
*Dated*—Simla, the 26th May 1909.
*No.*—581 I.

I am directed to acknowledge the receipt of your endorsement No. 462 I., dated the 10th December 1908, forwarding a copy of the Proceedings of the Government of Madras approving of the recommendation of their Chief Engineer for Irrigation to continue the detailed investigation of the Cauvery Reservoir Project.

2. With reference to the above, I am to enclose a copy of a note on the project by the Inspector-General of Irrigation, dated the 19th March 1909, and to invite special attention to paragraphs 12 to 14, in which Mr. Benton raises the question whether a point has not been reached in the progress of productive irrigation in the Madras Presidency, at which it becomes necessary to choose between a policy of enhancing the water-rate for rice on lands newly opened out to irrigation, or of recognising that further attempts to extend productive irrigation must be abandoned or seriously hampered. Mr. Benton has drawn a comparison between the rates charged for rice in Madras and those levied in the Punjab and the United Provinces. On this point I am to say that the Government of India recognise that conditions in Upper India are very different from those in Madras, that the system of assessment is not the same in the two localities and that no definite conclusions can, in consequence, be drawn from such a comparison alone. They are nevertheless inclined to think that in Madras there exist circumstances which are more favourable to the imposition of high water-rates than those obtaining in Upper India.

3. Taking the table of water-rates for rice attached to the Inspector-General's note, it would appear from the Upper India rates that, where rice cultivation is practicable, the value of water is greater than that assumed by the Government of Madras in calculating the revenue receipts of the Cauvery Project. It must at the same time be remembered that in Upper India the charge made for rice is lower than for some other crops in proportion to the quantity of water taken, because that crop requires irrigation at a time when there is ordinarily an abundant supply in the canals. Except in seasons of excessive drought, there is always more water available at that time of the year than there is any demand for, and the watering of rice does not interfere with the irrigation of other crops. The water is therefore supplied at a comparatively cheap rate. It would appear therefore that still higher rates for rice cultivation should be charged in Madras, where rice lands have to be watered at a time of the year when supplies are least abundant. It should also be borne in mind that, in his proximity to the sea-board, the Madras cultivator enjoys an advantage over the agriculturist in Upper India whose profits on exports are diminished by the cost of the transit charges of the grain to the coast.

4. The Government of India do not wish, however, to attach too much importance to the comparison discussed above. The main points for consideration are as follows: The Government of Madras appear to be disposed to view the rates for new works in the light of those assessed on existing ones. The position is, however, quite different from that of the old canals, where the current rates have become a part of the regular charges on agriculture and where the whole economic system might be affected by a substantial change in the rates. The conditions and requirements of the new works are different in every respect and seem to afford justification for a departure from the usual assessment.

5. The only irrigation schemes in the Madras Presidency that can now be advanced, are storage projects which will be difficult and costly to execute, having regard to modern high prices of labour. The Government of India share the apprehension of the Inspector-General of Irrigation that it may not be possible to class them as productive works if their financial forecasts are based on the existing water-rates. The only alternative course would be to abandon the idea of prosecuting a number of schemes that could be made profitable by a sensible, but not excessive, increase in the water-rates. The Government of India have no wish to press for any unreasonable increase in the charges made for water supplied, but the question is whether higher charges could not be paid on new works without any difficulty, and they are disposed to think that if the rates were pitched at an amount approximating to the market value of water, the cultivators would gladly pay them, rather than forego the sure and lasting benefits of irrigation.

6. In conclusion, I am to express the hope that the Governor in Council will give the close attention to this matter which its importance demands, having regard to its bearing on the future progress of irrigation in the Madras Presidency.

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ENCLOSURE.

*Note on the Cauvery Irrigation Project, Madras Presidency, by Mr. J. Benton, C.I.E., Inspector-General of Irrigation, dated 19th March 1909.*

I.—ADMINISTRATIVE.

*Condition of the investigations.*—This is detailed in the correspondence and reports received with letter No. 461 I., dated 10th December 1908, of the Government of Madras. The Chief Engineer's note of 1st December 1908 summarizes the conditions as they appeared at the time he dealt with the subject.

2. When on tour in Madras, I discussed this case with the local officers and was informed that later investigations went to show as follows:—

(i) That the available water-supply appeared to be inadequate for the larger projects with offtake from the Cauvery at Kattalai, but that the available data are not such as can be fully relied on.

(ii) That it is proposed to make special discharge observations throughout next monsoon, which will remove all doubts regarding the available water-supply.

(iii) That it is proposed to defer further surveys, both of the Kattalai and Grand Anicut projects, until next November, by which time it can be clearly determined what the available supply is.

I concur with the Chief Engineer for Irrigation in the advisability of following the procedure indicated in (ii) and (iii) *supra*.

3. *Proposed masonry dam.*—It was proposed in the project to construct a masonry dam of 129 feet in height on the Cauvery about five miles up-stream of Neringipet and to store water there for the irrigation of additional tracts in the Cauvery delta, and on canals to command certain other tracts of land on the right bank above the level of the delta. The doubtful points are chiefly as follows :—

(i) The supply hitherto used for the existing irrigation, and which indicates to some extent what will be needed for it in future, and the balance which was available for fresh areas of irrigation.

(ii) Whether the proposed reservoir at Neringipet will serve to admit of an adequate supply being furnished for the proposed increase of irrigation.

(iii) Whether a better site can be found for the reservoir than that hitherto investigated about five miles up-stream of Neringipet.

4. *Available water-supply.*—It appears that the supplies of water hitherto used were under-estimated, which resulted in promise of more extensive areas of additional irrigation being possible, than are now believed to be feasible. The treatment of the question of available water-supply adopted in the project was obscure and unconvincing—*vide* paragraph 24 of my note on this work, dated 17th September 1906. It is now proposed to end this uncertainty in the following manner :—

(i) To prepare from actual observation of numerous discharges in next flood season, discharge curves—

(*a*) for the gauge on Bhavâni bridge, Cauvery river, where there is a record of readings for 27 years, the river channel being rock and permanent ;

(*b*) for Kodiveri anicut near the outfall of the Bhavâni river, where there is a reliable gauge record going back 20 to 30 years.

(ii) To apply the discharge tables prepared from these curves to the past gauge records which will serve to show, day by day, the supply which actually entered the delta in the last 20 to 30 years.

(iii) The deduction of the supplies required for the known areas of irrigation at duties derived from the Kistna and Gódávari systems, will serve to show what balance was available for additional irrigation.

I understand that it is proposed to depute a fully-qualified Engineer officer to devote the whole of his time to observing discharges for (i) (*a*) and (*b*) *supra*, and to verify these by observation of the discharges and preparation of similar discharge curves and tables for the Upper Anicut. This question is one of very great importance, and I cordially concur in the proposals of the Chief Engineer for Irrigation. I would suggest that the officer selected, and the supervision of his work, may be such as to ensure perfectly reliable results. The effect of failing to attain this end, would be to throw back the project for another year.

5. I would venture to advise that reliance may be placed on obtaining the results required by the use of surface floats in preference to using current meters. In regular canalized channels, in which there is no trouble in inserting vertical velocity rods where desired and recovering the same, these would give even more accurate results than surface floats ; however, this procedure may not be feasible. We know the co-efficient to apply to surface velocities within fairly narrow limits. I would suggest that the whole of the arrangements may be made in advance,—discharge "runs" being set out and sectioned, all requisite gauges fixed and marked to hundredths of a foot,—all requisite boats, floats, etc., being had in readiness, and procedure to be definitely laid down both as regards observations and the working out of discharges. I would suggest the prompt submission to the Superintending Engineer of fortnightly reports for the first month or two, with all observation data and working up of the same fully exhibited ; it will then be easy to correct procedure in due time to avoid loss of the work of a year.

6. *Site of storage work.*—The site about five miles up-stream of Neringipet is favourable as regards the character of the rock, in the river bed ; however, the following disadvantages are seen to attach to this site :—

(i) The basin up-stream mostly consists of the narrow river channel with little water-spread and little capacity, there being very few lateral valleys.

(ii) It is necessary to add greatly to the height of the dam to secure a considerable addition to the storage.

(iii) Surplussing through the dam is essential for the whole of the flood waters, there being no side ridges or high ground suitable for an escape.

7. It is desirable, if possible, to select a site where the following would be possible :—

(i) Good rock for the foundations which would safely withstand the severe action of water surplussed from a considerable height.

(ii) Facilities for passing a considerable part of the surplussed water over high side ground with a rock foundation at a high level, so as to diminish the cost of sluices.

(iii) A wider waterspread for the high levels, so that abundance of storage capacity may be secured at a reasonable cost.

8. *Alternative site.*—Near Sampalli, about seven miles up-stream of the project site, such general maps as are available go to show that it may probably be feasible to find a rather better site than that of the project, and I agree with the Chief Engineer for Irrigation that this locality should be carefully examined, and if found suitable, that it should be surveyed and the capacity for different heights of dam ascertained. It is understood that usually there is no want of water-supply in the Cauvery river in most years, and that the chief requirements are as follows :—

(i) To procure ample storage at reasonable cost.

(ii) To provide surplussing arrangements which will serve to admit of silt deposits being largely scoured out of the reservior by keeping the sluices in the dam open for a considerable part of each flood season, as proposed by Colonel Smart, R.E., and approved by Sir T. Higham, K.C.I.E., formerly Inspector-General of Irrigation. The reservoir should be one which will remain efficient for a very long time.

9. *Extent of commanded area.*—The advantages of an extensive commanded area are as follows :—

(i) Wide distribution of the benefits of irrigation over a large population, since this is preferable to enriching a smaller number.

(ii) A wide market ensures good demand, and is conducive to high water-rates and good revenues ; the existing delta irrigation with areas not greatly in excess of what can be irrigated annually, and water-rates of, I believe, from one-third to one-half of the market value of the water, are examples of the disadvantages of a restricted commanded area which would, in my opinion, do well to avoid in the case of extensions. With a wider market, Government would be in a far better position to dispose of water at its market value.

10. The disadvantage of a commanded area greatly in excess of what can be irrigated annually, is the extra cost of conveying water to the same ; I am of opinion that this extra cost will be far outbalanced by the advantages—paragraph 9 (i) and (ii) *supra.* From a famine protective point of view, we would wish to have a commanded area of three to four times that of the annual irrigation ; this will not be feasible, and we are not considering a work to be classed as protective ; however, the general principle of endeavouring, as far as feasible, to do the greatest good to the greatest number, is still an object to aim at, provided the project is still sufficiently remunerative to fulfil the conditions of a productive work.

11. *Adoption of large or of small project.*—Provided the larger project with offtake at Kattalai can be made to fulfil the conditions of a productive work, I strongly advise adoption of the same in preference to the smaller one with an offtake at the Grand Anicut, my reasons being as follows :—

(i) Securing the advantages indicated in paragraph 9 *supra.*

(ii) Location of the anicut at a site where it would serve a large area on the opposite (left) side of the Cauvery river : provided additional storage works should be resolved on after construction of the work now under consideration. At Kattalai there is an extensive area on the left side which could be commanded ; at the Grand Anicut there is no such area.

(iii) Without a single exception, as far as I am aware, all past experience in India goes to show that narrow cramped projects not admitting of extension, have ultimately been found inferior to those schemed for the widest practicable scope, and have been bitterly regretted.

To get a project sanctioned at all, it is necessary to be able to show that it will be productive : if the larger project meets the conditions of works of that class, but promises to yield, say, 1 per cent. to $1\frac{1}{2}$ per cent. less of a return on the capital cost in the near future, it would, in my opinion, still appear advisable, for the reasons (i) to (iii) *supra*, to adopt the work of larger scope in preference to the smaller one.

## II.—FINANCIAL.

12. *Water-rates.*—The possibility of irrigation extensions by the execution of large costly projects in Madras Presidency has largely resolved itself into a question of water-rates; this is true of—

(*a*) Cauvery scheme,

(*b*) Kistna scheme,

since in these cases protective works are unwarrantable owing to the small expenditure which has been incurred on famine-relief operations in the past. The water-rates adopted in the preliminary report, pages 11 and 12, are as follows :—

| | Per acre. RS. |
|---|---|
| First crop ... ... ... ... ... ... ... ... | 4·68. |
| Second crop ... ... .. ... ... ... ... ... | 2·91 to 3·71 |

Doubtless these are safe rates, certain to be realizable in the light of those now assessed on existing irrigation works; however, the following questions arise :—

(i) Do these rates represent the market value of the water?

(ii) If the rates are not market ones, but have merely been advanced from consideration of existing rates elsewhere, is it necessary to be guided by these considerations in the case of such portions of the new irrigation as can be treated on a different basis from the area now watered?

(iii) With an extensive commanded area and keen demand, would the people willingly give much higher rates rather than have no project, such as now under consideration?

All the Irrigation officers and such of the Revenue officers as I have had the advantage of discussing these questions with, when on tour, appeared to me to give an emphatic negative to (i) *supra*. The matter (ii) is one which I am not circumstanced from lack of local knowledge to discuss. The reply to the question (iii) will assuredly be that the people would desire to have the project and to pay much higher rates than paid at present on existing works; but when they get the new works, they will not be human, if they do not urge that they should be treated as leniently as existing irrigators elsewhere.

13. The market rates for produce have, I understand, risen greatly in recent years, since existing settlements were made, and apparently there is no good reason to suppose that the value of produce will ever return to the previous low level. Existing long settlements of thirty years with consolidated rates for land revenue, and water-rates, cannot be disturbed until the expiry of the settlement.

14. The question discussed in paragraphs 12—14 *supra* is primarily one for the Revenue officers as to what is realizable, for Government as to what is expedient and politic and for the Irrigation officers as to the projects which will be productive and possible of execution under existing rules for this class of works. With the completion of the simple cheap delta works years ago, all the most favourable projects have already been executed and we are now left with difficult costly works requiring storage and which involve, acre for acre, about twice as much expenditure as the executed works. If the Irrigation officers can calculate on considerably higher rates than hitherto advanced, but well under market rates, Madras can have numerous large projects and the country will be much improved by their execution; if, however, the Irrigation officers can only calculate on the water-rates of by-gone times, and which, I understand, are far less than the value of the water to the people, then the Irrigation officers may find it quite impossible to procure sanction under existing rules for works to supply water at these low rates. The Cauvery and Kistna projects are works of great promise, but they are both on the border of what is allowable under existing water-rates and rules. An extra water-rate of a rupee or two an acre, out of the extra rates over existing ones, which the people could well afford to give and would willingly give rather than not have irrigation, may make all the difference—between execution and rejection—between advancement and stagnation. The appendix to this note shows that the Madras water-rates for rice are on the average much below those of the Northern India. Since the Madras works are on the sea, there may be an advantage of Rs. 7 per acre on the produce of every acre which is exported, in the saving of the railway freight; if one-third is exported, Madras could probably afford to pay at least Rs. 2 more per acre than the up-country provinces, but instead of this being the case, the former pays about Rs. 2 less per acre. Leniency in assessment has a great deal in its favour, but should it be carried out to an extent which may effectually bar advancement in the Presidency for the good of the people? For these reasons, I would venture to suggest that the Local Government may be asked to reconsider the question of water-rates which will be realizable in new tracts where existing settlements do not bar advancement of rates.

J. BENTON,
*Inspector-General of Irrigation.*

APPENDIX.

COMPARISON of water-rates for rice on the principal irrigation works in various provinces.

| Province. | Canal system. | Water-rate, direct and indirect, per acre. RS. A. P. |
|---|---|---|
| | *As per schedule of rates.* | |
| Punjab | Western Jumna | 6 3 0 |
| | Upper Bari Doab | 6 4 10 |
| | Sirhind canal | 5 4 0 zone I.<br>5 0 0 zone II. |
| | Lower Chenab | 7 12 0 |
| | Lower Jhelum | 6 4 0 |
| | Agra (where in Punjab) | 5 5 0 |
| United Provinces | Upper Ganges | 6 10 8 |
| | Lower Ganges | 4 0 0 |
| | Agra | 4 0 0 |
| | Eastern Jumna | 6 10 8 |
| | *As per triennial report ending* 1904–1905. | |
| Madras | Cauvery | 4 6 9 |
| | Kistna | 4 9 11 |
| | Gódávari | 4 0 2 |
| | *Proposed new projects.* | |
| Madras | Cauvery | 4 10 11 first crop. (*a*)<br>3 11 4 second crop. |

(*a*) This shows the average rate which can be credited to the project during the present settlement. If there were no liabilities to supply water, to existing wet lands, the average rate would be Rs. 4–15–3.

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**Order—No. 256 I., dated 15th June 1909.**

The letter from the Government of India last read above will be communicated to the Superintending Engineer on Special duty for information and guidance.

2. The question of the enhancement of water-rate for rice on lands newly opened out for irrigation will be dealt with in the Revenue Department.

(True Extract.)

C. A. SMITH,
*Joint Secretary to Government, P.W.D.,*
*Irrigation Branch.*

To the Chief Engineer for Irrigation.
,, the Superintending Engineer on Special duty.
,, Superintending Engineers, V and VI Circles.
,, the Examiner, Public Works Accounts.
,, the Revenue Department.

# Government of Madras.

## PUBLIC WORKS DEPARTMENT.

IRRIGATION.
ACCOUNT.

| | | |
|---|---|---|
| *Recd.* | 1909. | *Enclosures* |
| *Regd.* | | *Spare copies* |

## G.O., Nos. 257, 258 I., 16th June 1909.

**Crane to raise the falling shutters of the Kistna Anicut**

Approving an estimate of Rs. 12,915 for installing a — and forwarding for early sanction a copy of the Proceedings together with the plans and estimate for the work.

GOVERNMENT OF MADRAS.

PUBLIC WORKS DEPARTMENT.

---

**Irrigation.**
**Account.**

Read— the following papers:—

I

**G.O., No. 19 I., dated 20th January 1909.**

Abstract.—Approving the installation of a crane and rails on the Bezwada anicut for raising its falling shutters and ordering copy of the Proceedings to be forwarded to the Government of India for confirmation.

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II

**G.O., No. 191 I., dated 7th May 1909.**

Abstract.—Communicating to the officers concerned letter from the Government of India confirming the permission accorded to Superintending Engineer, II Circle, to proceed, in anticipation of sanction to the estimate, with the work of installing a crane and rails on the Bezwada anicut for raising the falling shutters.

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III

*Letter*—from S. B. Murray, Esq., A.M.I.C.E., Superintending Engineer, II Circle.
*To*—the Chief Engineer for Irrigation.
*Dated*—Bezwada, the 8th May 1909.
*No.*—50 I.

With reference to G.O., No. 19 I., dated 20th January 1909, I have the honour to forward herewith, for the sanction of Government, an estimate amounting to Rupees 10,500 for "installing a crane running on rails for raising the falling shutters of the Kistna anicut."

2. The work is in progress and will be completed before the flood season.

---

Enclosure.

*Report to accompany the estimate for "installing a crane running on rails to raise the falling shutters of the Kistna anicut."*

| | RS. |
|---|---|
| Amount of estimate ... ... ... ... ... ... ... | 10,500 |

There are 3,077 running feet of falling shutters, and lifting them by hand against an appreciable flow of water over the anicut is a slow and tedious operation. Experiments were made last year with a 2-ton crane, and it was found that a shutter could be easily lifted in a few minutes against a head of $2\frac{3}{4}$ feet. The result was so satisfactory that it was decided to lay down rails right along the anicut, and to maintain a crane for lifting purposes.

2. The rails will be laid flush with the top of the anicut, and the upstream one will be just clear of the shutters when they are down. They will be laid at the same level for the whole length of the anicut, except at the left flank where there is a short length of anicut without falling shutters, and with its crest wall level with the top of the shutters when they are up. In this length the rails will be laid at a gradient, rising from + 46·75 to + 49·75 in a distance of 70 feet. At the top of the gradient there will be a turntable with rails leading to the front face of the anicut. For the bottom 50 feet of this gradient, the crest wall will be cut away, and five falling shutters of different depths will be fitted.

3. The modus operandi will be as follows:—

When the water level in the river falls below + 49·75, and it is necessary to raise some or all of the shutters, the crane will be put on to a low punt and taken out to the left end of the anicut, and landed on to the rails. It will then be taken down the gradient, lifting each shutter, which will be fitted with a shackle, as it goes along. The jib is sufficiently long to enable the crane to be entirely sheltered by the last shutter raised while it is lifting the next one in front.

An existing crane is available in the Bezwada shops for use on this work, and all that is required is a set of wheels, for which provision has been made in the estimate.

S. B. MURRAY,
*Superintending Engineer, II Circle*

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## IV

### Note by the Chief Engineer for Irrigation.

In G.O., No. 19 I., dated 20th January 1909, the action of the Chief Engineer for Irrigation in having permitted the Superintending Engineer, II Circle, to proceed in anticipation of sanction to the estimate with the work of installing a crane running on rails on the Bezwada anicut for raising the falling shutters was approved and a copy of the Proceedings was forwarded to the supreme Government with a request to confirm the permission accorded by the local Government. In their letter No. 374 I., dated 19th April 1909, the Government of India, while confirming the action of the local Government, observed that plans showing how the rail-track being laid would answer present and future requirements should have been submitted to make the reference complete.

2. With his letter read above, the Superintending Engineer, II Circle, now submits an estimate, amounting to Rs. 10,500, for the work. It is stated that the work is in progress and will be completed before the flood season.

3. Paragraph 2 of the report states that the upstream rail will be just clear of the shutters when down but it is observed that there is actually a space of 1′ 9″ between the top of the present shutters when down and the rail.

4. It will be seen from the accompanying cross section that the upstream rail will not be clear of a 6 ft. shutter of the Rupar pattern; but this does not appear to be essential; it is however open to question whether the Rupar pattern without some modification will be suitable to the requirements of the Bezwada anicut. It is also observed from the plan of the Rupar shutters and description of their working that a crane running on broad guage wheels is used and that the inner rail is not clear of the shutters when down. It cannot therefore be stated at present whether the rails as now laid will require alteration or not and it was not practicable to settle this without delaying the work.

The estimate is recommended for sanction.

C. A. SMITH,
*Chief Engineer for Irrigation.*

*10th June* 1909.

**Order—No. 257 I., dated 16th June 1909.**

The following estimate is approved :—

Imperial.

Capital Expenditure not charged to Revenue.

49. Irrigation.

Kistna Delta System.

Central Division.

Open Capital Account.

I. Works.

1. Head Works.

C. Works.

Unremunerative Work.

Installing a crane running on rails to raise the falling shutters of the Kistna anicut.

| | RS. |
|---|---|
| Estimate— | |
| I. Works ... ... ... ... ... ... ... ... | 10,500 |
| II. Establishment ... ... ... ... ... ... ... | 2,415 |
| Total ... | 12,915 |

2. Ordered that a copy of these Proceedings, together with the plans and estimate for the work, be forwarded to the Government of India with the request that sanction thereto may be communicated at an early date.

[Here enter No. 258 I., dated 16th June 1909.]

(True Extract.)

C. A. SMITH,
*Joint Secy. to Govt., P.W.D.,*
*Irrigation Branch.*

To the Chief Engineer for Irrigation.
,, Superintending Engineer, II Circle.
,, Examiner, Public Works Accounts.

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**Endorsement—No. 258 I., dated 16th June 1909.**

Forwarded.

(By Order.)

C. A. SMITH,
*Joint Secy. to Government, P.W.D.,*
*Irrigation Branch.*

# Government of Madras.

## PUBLIC WORKS DEPARTMENT.

IRRIGATION.
ACCOUNT.

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| *Recd.* | 1909. | *Enclosures* |
| *Regd.* | | *Spare copies* |

## G.O., No. 259 I., 16th June 1909.

**Diversion of the Coleroon Right Bank, Tanjore district**

The estimate of Rs. 15,540 for the —, sanctioned with remarks.

GOVERNMENT OF MADRAS.

PUBLIC WORKS DEPARTMENT.

**Irrigation.**
**Account.**

Read—the following papers :—

I

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| From the Superintending Engineer, | V Circle, | dated | 11th Jan. | 1909, | No. | 10 E.I. |
| To the | ,, | V ,, | ,, | 3rd Feb. | ,, | ,, | 374. |
| From the | ,, | V ,, | ,, | 26th ,, | ,, | ,, | 85 E.I. |
| To the | ,, | V ,, | ,, | 16th Mar. | ,, | ,, | 1031. |
| From the | ,, | V ,, | ,, | 5th May | ,, | ,, | 172 E.I. |
| To the | ,, | V ,, | ,, | 14th ,, | ,, | ,, | R.O.C. 80. |

Enclosure.

*Report to accompany the estimate for Diverting the Coleroon Right Bank between* 20/7 *and* 21/7.

| | RS. |
|---|---|
| Amount of estimate ... ... ... ... ... ... ... | 15,540 |

During the floods of August last the right bank of the Coleroon from 21/3 to 21/5 was washed away in consequence of a sudden and determined set. As the width between banks in this locality is very restricted it was decided to divert the bank as shown in the survey sketch attached to this estimate, the proposal being approved of in Superintending Engineer's No. 694-T.J., dated 30th August 1907. The locality was also inspected and the proposals approved of by the present Superintending Engineer during his last inspection of the Coleroon. Between 18/6 and 25/2 the river has a fall of over 3 feet and consequently there are many erosions along the Right Margin which require protection. As work in this locality will be greatly facilitated if the bank be made wide enough for carts to take materials for erosions, a top width of 9 feet has been provided for. The top of the new bank will be gravelled 2" thick.

A. H. Morin,
*Executive Engineer, Cauvery Division.*

19*th February* 1909.

II

**Note by the Chief Engineer for Irrigation, dated 9th June 1909.**

The papers read above relate to the diversion of the Coleroon Right Bank from 20/7 to 21/7, for which the Superintending Engineer, V Circle, sanctioned in his Circle register No. 332 of 1907–1908, an estimate of Rs. 15,540 classed under "Repairs". As the work was of the nature of "Original Works" and as such was beyond the Superintending Engineer's powers of sanction, he was asked to submit the plans and estimate to this office for obtaining the sanction of Government thereto. He now submits the estimate, the necessity for which is explained in the report accompanying it. It is recommended that the estimate be sanctioned.

2. It is observed that no data have been furnished by the Superintending Engineer to ascertain how the rate of Rs. 4-4-0 per unit of 1,000 c. ft. allowed in the estimate for earthwork has been arrived at, but it is presumed that he has satisfied himself as to its correctness and it may be accepted.

3. The provision of Rs. 6,500 made in the estimate for land compensation has not been fixed in consultation with the Local Revenue Officers as required by paragraph 800 of the Public Works Department Code, and the Superintending Engineer has been requested to verify the figure in communication with the Collector. It is however stated by the Superintending Engineer that the rates have been based upon those actually paid for similar lands acquired in the neighbourhood and may for the present be accepted.

C. A. SMITH,
*Chief Engineer for Irrigation.*

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**Order—No. 259 I., dated 16th June 1909.**

The following estimate is sanctioned in supersession of the estimate sanctioned by the Superintending Engineer, V Circle, in his Circle register No. 332 of 1907-1908 :—

Provincial.
Irrigation.
43. Minor Works and Navigation.
Class V—Agricultural Works.
Original Works.
Cauvery Division.
Diverting the Coleroon Right Bank from 20/7 to 21/7.

| | RS. |
|---|---|
| Estimate ... ... ... ... ... ... ... ... | 15,540 |

2. This sanction is registered as No. 40 I. of 1909-1910.

3. The attention of the Superintending Engineer, V Circle, is drawn to paragraphs 2 and 3 of the foregoing note by the Chief Engineer for Irrigation.

(True Extract.)

C. A. SMITH,
*Joint Secretary to Govt., P.W.D.,*
*Irrigation Branch.*

To the Chief Engineer for Irrigation.
" Superintending Engineer, V Circle, with plans and estimate.
" Examiner, Public Works Accounts.

# Government of Madras.

## PUBLIC WORKS DEPARTMENT.

IRRIGATION.
ACOCUNT.

*Recd.* } 1909. *Enclosures*

*Regd.* *Spare copies*

## G.O., No. 262 I., 18th June 1909.

**Diversion of the Kistna right flood bank near the Vellatur village, Kistna Central Division**

The revised estimate, amounting to Rs. 12,370, for the —, sanctioned with remarks.

GOVERNMENT OF MADRAS.

PUBLIC WORKS DEPARTMENT

**Irrigation.**
**Account.**

Read—the following papers :—

I

**G.O., No. 320 I., dated 9th September 1908.**

II

*Letter*—S. B. Murray, Esq., A.M.I.C.E., Superintending Engineer, II Circle.
*To*—the Chief Engineer for Irrigation.
*Dated*—Bezwada, the 8th March 1909.
*No.*—15-I.

I have the honour to forward herewith for the sanction of Government a revised estimate, amounting to Rs. 12,370, for "Diversion of Kistna right flood bank along Vellatur ring bund including a realignment."

2. The original estimate of Rs. 6,386 was sanctioned in G.O., No. 320 I., dated 9th September 1908, and the necessity for the revision is explained in the report and comparative statement accompanying the revised estimate.

3. The contribution of Rs. 2,000 has been collected from the ryots of Vellatur through the Revenue Department and I have issued orders to the Executive Engineer, Kistna Central Division, to carry out the work in anticipation of sanction to the revised estimate.

4. I have inspected this village and I wish to raise the general question of Government's liability as regards the protection of villages built on the river side of our flood banks. There is nothing special about Vellatur. Every village situated inside the flood banks has an equally good claim to a protective bund. In the case of Vellatur, Government already has a good strong flood bank along the line of the canal, but now an expenditure of over Rs. 10,000 of Government money is to be incurred to protect the village, and not only a village but also a large area of cultivated land belonging to the village. The area referred to is shown on the survey by green lines. The reason why this land is to be protected is that in G.O., No. 320 I., dated 9th September 1908, it was ordered that the Public Works Department flood bank should be taken along the line of the old ring bund. This has been done.

5. A certain amount of realignment for the new flood bank is necessary as the old ring bund is in places very irregular as to size, shape and direction.

No. 262 I., 18TH JUNE 1909. 

ENCLOSURES.

*Report to accompany the revised estimate for diversion of Kistna right flood bank along Vellatur ring bund including a realignment.*

| | Rs. |
|---|---|
| Amount of original estimate ... ... ... ... ... ... | 6,386 |
| " revised estimate ... ... ... ... ... ... | 12,370 |

The original estimate of Rs. 6,386 was sanctioned in G.O., No. 320 I., dated 9th September 1908.

2. Provision for (i) land compensation, (ii) cost of earth and (iii) petty supervision and contingencies was omitted or wrongly calculated in the rough estimate of Rs. 6,386 sent with this office No. 479-S.E., dated 7th September 1907, and sanctioned in G.O., No. 320 I., dated 9th September 1908. These items which are all necessary, are now provided for in the revised estimate, and cause an excess of Rs. 5,984 over the original sanctioned estimate.

3. The Collector, Guntúr, reported in his letter No. 402-Gl., dated 5th February 1909, that the contribution of Rs. 2,000 referred to in paragraph 4 of G.O., No. 320 I., dated 9th September 1908, has been recovered from the ryots of Vellatur and credited in Tenali treasury, and the Superintending Engineer, II Circle, thereon ordered in his No. 886-K.C., dated 24th February 1909, that the estimate for the diversion of Kistna right flood bank along the existing line of Vellatur ring bund, including a realignment, was approved by him and that the work should be set out at once.

4. The work was accordingly set out on 26th February 1909, with a realignment, meeting the flood bank at 10 feet above the point where the old ring bund meets the right flood bank at $\frac{32}{2}$ + 500. The revised estimate provides for all the items necessary.

5. The amounts allowed for land compensation are based on rates supplied by the Revenue Department.

M. BROWN,
*Executive Engr., Kistna Central Divn.*

ESTIMATE FORM—Comparative statement of differences.

| Description of work. | Original estimate. | | | Revised estimate. | | | More. | Less. | Explanation of difference. |
|---|---|---|---|---|---|---|---|---|---|
| | Quantity. | Rate. | Amount. | Quantity. | Rate. | Amount. | | | |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| DIVERSION OF KISTNA RIGHT FLOOD BANK ALONG THE EXISTING LINE OF THE VELLATUR RING BUND INCLUDING A REALIGNMENT. | UNITS. | RS. A. P. | RS. | | RS. A. P. | RS. | RS. | RS. | |
| *Original estimate sanctioned in G.O., No. 320 I., dated 9th September* 1908. | | | | | | | | | |
| Earthwork .. .. .. .. | 1,703 | 3 12 0 | 6,386 | 1,748 | 5 0 0 | 8,740 | 2,354 | . | Excess in quantity is due to the slight alteration in the line which was found necessary and the excess in rate is due to the increase of wages of a man from As. 3 to As. 4 per day. |
| Clearing jungle .. .. .. | .. | .. | .. | .. | .. | 35 | 35 | .. | Provision was not made in the original estimate for clearing jungle, petty supervision and contingencies and for cost of earth. These items have been found necessary during execution. |
| Petty supervision and contingencies | .. | .. | .. | .. | .. | 141 | 141 | .. | |
| Cost of earth .. .. .. . | .. | .. | .. | 1,748 | 0 6 2 | 674 | 674 | .. | |
| Total .. | .. | .. | 6,386 | .. | .. | 9,590 | 3,204 | .. | |
| *Compensation for land.* | | | | | | | | | |
| Seri .. .. .. .. .. | .. | .. | .. | ACS. 3·64 | 300 0 0 | 1,092 | 1,092 | .. | No provision was made in the original estimate for this sub-head. |
| Inam .. .. .. .. .. | .. | .. | .. | 3·78 | 350 0 0 | 1,323 | 1,323 | .. | The provision now made is necessary and is based on the figures supplied by the Revenue Department. |
| Compulsory occupation .. .. .. | .. | .. | .. | .. | .. | 365 | 365 | .. | |
| Total .. | .. | .. | .. | .. | .. | 2,780 | 2,780 | .. | |
| Grand total .. | .. | .. | 6,386 | .. | .. | 12,370 | 5,984 | .. | Excess over the original estimate. |

NOTE.—The original estimate was sanctioned in G.O., No. 320 I., dated 9th September 1908.

P. H. DAWSON,
*Executive Engineer, Kistna Central Division.*

## III

Telegram from the Sambrajya Pradayani Sabha, dated 6th May 1909.

## IV

### Memorandum No. 40–O, dated 7th May 1909.

In continuation of this office telegram, dated 26th April 1909, reproduced in the margin, the Superintending Engineer, II Circle, is requested to proceed with the work on the flood bank of the Kistna river round Vellatur village. Orders on the revised estimate will issue in due course.

"Your No. 15-I., eighth instant. Stop work on flood bank round Vellatur village pending disposal of revised estimate."

2. With reference to paragraph 2 of his No. 15-I., dated 8th March 1909, and the general question therein raised, he is referred to his No. 301-I., dated 16th September 1907, and the other correspondence printed with G.O., No. 320 I., dated 9th September 1908. As regards the protection of the cultivated land, the proposal to follow the line of the old ring bund was his own—*vide* paragraph 3 of his letter quoted above. If the flood bank can be carried round the village on a more economical line and the work is not too far advanced to allow of the change being made, there is no objection to make change of alignment.

3. With reference to his telegram, dated 6th instant, the Secretary of the Sambrajya Pradayani Sabha is informed that orders are being issued to proceed with the work on the flood bank near Vellatur.

C. A. SMITH,
*Joint Secy., to Govt., P.W.D., Irrigation Branch.*

To the Superintending Engineer, II Circle.
" Secretary, Sambrajya Pradayani Sabha (paragraph 3 only).

## V

### Note by the Chief Engineer for Irrigation.

In G.O., No. 320 I., dated 9th September 1908, an estimate, amounting to Rs. 6,386, was sanctioned for the diversion of the Kistna flood bank near the Vellatur village, Kistna Central division. The Superintending Engineer, II Circle, now submits a revised estimate of Rs. 12,370, showing an excess of Rs. 5,984 over the original estimate for the work. This excess is made up of the following items :—

| | RS. |
|---|---|
| (1) Earthwork ... ... ... ... ... ... ... .. | 2,354 |
| (2) Compensation for taking earth, etc. ... ... ... | 850 |
| (3) " land ... ... ... ... ... ... | 2,780 |
| Total ... | 5,984 |

It is stated that the excess on item (1) is due to increase in rate and also to a slight alteration in the alignment of the bund, and that under (2) and (3) to the requisite provision for these items not having been made in the original estimate. As regards item (3) it is observed that the necessity for the provision for land compensation should have been foreseen and the original estimate, the details of which are given in the Sub-Divisional Officer's letter on page 4 of G.O., No. 320 I., dated 9th September 1908, appears to have been very carelessly prepared by the Sub-Divisional Officer in the first instance and insufficiently scrutinised by the Executive Engineer.

The revised estimate is recommended for sanction.

2. The Superintending Engineer has been permitted to proceed with the work in anticipation of sanction to the estimate, and he has been told that if the flood bank can be carried round the village on a more economical line and if the work is not too far advanced to change the alignment, there is no objection to the alteration being now made.

3. With reference to the general question raised in the Superintending Engineer's letter of Government's liability as regards the protection of villages on the river side of flood banks, it will be seen from G.O., No. 2198, Revenue, dated 2nd September 1907, that Government are not in favour of incurring expenditure on such works. In the present case the original reason for recommending a departure from the general policy was that the village is so situated that the flood bank could be easily diverted so as to protect it at a comparatively small cost, but owing to the reasons given in paragraph 1 *supra* the cost to Government has now been considerably increased.

This case should not, however, be cited as a precedent and similar cases that may arise in future may be dealt with on their merits.

C. A. Smith,
*Chief Engineer for Irrigation.*

26*th May* 1909.

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**Order—No. 262 I., dated 18th June 1909.**

The revised estimate, amounting to Rs. 12,370, for diverting the Kistna right flood bank near the Vellatur village, Kistna Central division, is sanctioned in supersession of the estimate sanctioned in G.O., No. 320 I., dated 9th September 1908.

2. This sanction is registered as No. 41 I. of 1909–10.

3. The action of the Chief Engineer for Irrigation in having permitted the execution of the work in anticipation of sanction to the revised estimate is approved.

4. The attention of the Superintending Engineer is drawn to the remarks of the Chief Engineer for Irrigation in paragraphs 1 and 3 of his note and he should inform the officers concerned of the Government's displeasure at the perfunctory and careless manner in which the estimates were prepared and scrutinised.

5. Government agree with the remarks of the Chief Engineer for Irrigation in paragraph 3 of the preceding note. The protection of villages from floods is not a proper subject for the expenditure of funds derived from the general revenues.

(True Extract.)

C. A. Smith,
*Joint Secy. to Govt., P. W.D.,*
*Irrigation Branch.*

To the Chief Engineer for Irrigation.
,, Superintending Engineer, II Circle, with plans and estimate.
,, Examiner, Public Works Accounts.
,, Board of Revenue (Land Revenue).
,, Revenue Department.

# Government of Madras.

## PUBLIC WORKS DEPARTMENT.

IRRIGATION.
ACCOUNT.

*Recd.* } 1909.
*Regd.*

*Enclosures*

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## G.O., No. 263 I., 19th June 1909.

**Kandukur-Vyasasamudram tank, Cuddapah district**

The revised estimate, amounting to Rs. 5,445, for constructing the high and low level sluices to the —, sanctioned with remarks.

GOVERNMENT OF MADRAS.

PUBLIC WORKS DEPARTMENT.

**Irrigation.**
**Account.**

READ—the following papers :—

I

**G.O., No. 518 I., dated 14th May 1906.**

II

*Letter*—from P. R. ALLEN, Esq., M.I.C.E., Superintending Engineer, III Circle.
*To*—the Chief Engineer for Irrigation.
*Dated*—Bellary, the 1st May 1909.
*No.*—2726.

I have the honour to forward, for favour of sanction of Government, revised estimate, amounting to Rs. 5,320, for constructing high and low level sluices to No. 96 Kandukur Vyasasamudram tank, Madanapalle taluk, in lieu of that sanctioned for Rs. 3,000 in G.O., No. 518 I., dated 14th May 1906.

2. The excess is chiefly due to the provision made for equilibrium plug valves having been increased four times as much as the original provision as per the debit advice received from the Workshop and to the rates having been increased for masonry concrete and pointing on account of the insufficient provision made in the original estimate. Data is attached in support of the rates now provided.

3. I beg to submit that the excess now shown was anticipated as early as August 1908 and orders were issued for the preparation of revised estimate. The revised estimate was received in this office on the 20th of March 1909 and orders have been issued to the Executive Engineer to have the work completed without any further delay so that no damage may be done to the work during the coming rains.

ENCLOSURES.

*Report to accompany the revised estimate for Kandukur Vyasasamudram tank, Imperial No. 96, Madanapalle taluk.*

| | |
|---|---|
| | RS. |
| Amount of revised estimate ... ... ... ... ... ... | 5,320 |
| „ original „ ... ... ... ... ... ... | 3,000 |
| Excess ... | 2,320 |
| | ACS. |
| Ayacut ... ... ... ... ... ... ... ... ... | 1,631 |
| | RS. |
| Assessment ... ... ... ... ... ... ... ... | 10,412 |

This estimate is revised since the rates for many of the items are considerably low and not workable, they not having been based on proper lead and with reference to special difficulty, consequent on the powerful springs around sluice whose sill is about 18 feet below bed. Lump sum provisions made are too inadequate to meet the cost of difficult works involved.

The Workshop debit has become considerable, *i.e.*, nearly three times the amount provided for. The cost of carting the valves from Mulakhalacheruvu Railway station to site is about Rs. 100 and hoisting and erection would cost a like amount.

For want of piece workers to undertake this difficult work, it is proposed to get the same done departmentally by stationing the overseer Madanapalle on the tank. He is furnished with an imprest. The work is started in anticipation of sanction to revised estimate.

*27th February* 1909.

C. N. SUBRAMANIA AIYAR,
*Sub-Divisional Officer.*

## Estimate Form—Comparative statement of differences.

| Description of work. | Original estimate. | | | Revised estimate. | | | More. | Less. | Explanation of difference. |
|---|---|---|---|---|---|---|---|---|---|
| | Quantity. | Rate. | Amount. | Quantity. | Rate. | Amount. | | | |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| **Kandukur Vitasamudram Tank.** | | | | | | | | | |
| *Low level sluice.* | | RS. A. P. | RS. | | RS. A. P. | RS. | RS. | RS. | |
| Concrete in surki mortar .. .. | 8·90 | 9 12 0 | 87 | 7·42 | 15 12 0 | 117 | 30 | .. | Increase in this and following items since the original rates were not based on proper data and they were unworkable and fresh enhanced rates are now allowed as per actual lead and cost of materials. |
| Concrete with the 10 per cent. cement .. | .. | .. | .. | 1·48 | 20 0 0 | 30 | 30 | .. | |
| Burnt stone in surki mortar .. .. | 24·60 | 19 0 0 | 467 | 24·60 | 27 0 0 | 664 | 197 | .. | |
| Seigniorage .. .. .. .. | Lump sum. | | 15 | 24·60 | 0 7 6 | 12 | .. | 3 | |
| Cut stone work .. .. .. | 41 | 0 8 0 | 20 | 41 | 1 4 0 | 51 | 31 | .. | |
| Seigniorage .. .. .. .. | .. | .. | .. | 41 | 0 0 3 | 1 | 1 | .. | |
| Pointing with surki mortar .. .. | 25·50 | 1 12 0 | 45 | 12·25<br>12·25 | 2 6 0<br>4 0 0 | 78 | 33 | .. | |
| Teak wood wrought and put up .. .. | 41·5 | 4 10 0 | 192 | 41·5 | * 5 0 0 | 208 | 16 | .. | * The latest schedule gives only 4-10-0 per cubic foot. |
| Equilibrium Plug value .. .. | Lump sum. | | 300 | | | | | | |
| Equilibrium including railway freight from Madras to Molakalacheruvu. | .. | .. | .. | .. | .. | 851 | | | |
| Carting charges from Molakalacheruvu to the site. | .. | .. | .. | Lump sum. | | 60 | 661 | .. | The value of this and that for the other sluice have been intimated by the Superintendent, Public Works Stores, as Rs. 1,511 in all. |
| Hoisting and fixing in position .. .. | .. | .. | .. | Lump sum. | | 50 | | | |
| Forming approach bank .. .. .. | Lump sum. | | 10 | Lump sum. | | 30 | 20 | .. | Provision in the original estimate is inadequate. |
| Excavating foundation, putting ring bund, baling water, etc. | Lump sum. | | 200 | Lump sum. | | 350 | 150 | .. | Do. do. |
| Removing and repacking revetment with ¼ new stones. | Lump sum. | | 25 | 18·00 | 4 0 0 | 72 | | | † Rs. 1-6-6 is the actual cost. Provision in the original estimate is inadequate. Revetments should be removed so as to have a wide trench for foundation. |
| Seigniorage .. .. .. .. | .. | .. | .. | 4·50 | 0 5 0 | † 2 | 67 | .. | |
| Gravel backing .. .. .. | .. | .. | .. | 9·00 | 2 0 0 | 18 | | | |
| Repairs to the rear cistern .. .. | .. | .. | .. | Lump sum. | | 40 | 40 | .. | Repairs to this are necessary to put it in good condition. |
| Contingencies .. .. .. .. | .. | .. | .. | 5 per cent. | | 61 | 61 | .. | |
| Supervision .. .. .. .. | .. | .. | .. | 2½ per cent. | | 33 | 33 | .. | |
| Total .. | .. | .. | 1,861 | .. | .. | 2,728 | 1,370 | 3 | |
| *High Level Sluice.* | | | | | | | | | |
| Concrete in surki mortar .. .. | 6·50 | 9 12 0 | 63 | 6·50 | 15 12 0 | 102 | 39 | .. | |
| Seigniorage .. .. .. .. | .. | .. | .. | 6·50 | 0 5 0 | 2 | 2 | .. | |
| Burnt stone in surki mortar .. .. | 15·70 | 19 0 0 | 298 | 15·7 | 27 0 0 | 424 | 126 | .. | |
| Seigniorage .. .. .. .. | Lump sum. | | 10 | 15·7 | 0 7 6 | * 8 | .. | 2 | * Rs. 7-6-0. |
| Cut stone work .. .. .. | 28·00 | 0 8 0 | 14 | 28 | 1 4 0 | 35 | 21 | .. | Same remark as for low level sluice. |

## Estimate Form—Comparative statement of differences—*cont.*

| Description of work. | Original estimate. Quantity. | Original estimate. Rate. | Original estimate. Amount. | Revised estimate. Quantity. | Revised estimate. Rate. | Revised estimate. Amount. | More. | Less. | Explanation of difference. |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| KANDUKUR VIYASASAMUDRAM TANK—*cont.* | | | | | | | | | |
| *High Level Sluice*—cont. | | RS. A. P. | RS. | | RS. A. P. | RS. | RS. | RS. | |
| Seigniorage .. .. .. .. | .. | .. | .. | 28 | 0 0 3 | .. | .. | .. | |
| Pointing with surki mortar .. .. | 14·30 | 1 12 0 | 25 | 14·30 | 2 6 0 | 34 | 9 | .. | |
| Teakwood wrought and put up .. .. | 30·00 | 4 10 0 | 139 | 30·00 | 5 0 0 | 150 | 11 | .. | |
| Earthwork excavation .. .. .. | Lump sum. | | 50 | Lump sum. | | 50 | .. | .. | |
| Baling water and providing ring bund, etc. | Lump sum. | | 75 | Lump sum. | | 150 | 75 | .. | |
| Equilibrium plug valve, etc., including freight from Madras to Mulacalacheruvu, etc. | Lump sum. | | 250 | as per above. | | 660 } | 490 | .. | This should be Rs. 660 as the value of the two equilibrium plug valve (Rs. 851 + 660) = Rs. 1,511 as given in the previous page. |
| Carting charges from Mulacalacheruvu to site. | Lump sum. | | .. | .. | .. | 40 } | | | |
| Hoisting and fixing, etc. .. .. | Lump sum. | | .. | .. | .. | 40 } | | | |
| Removing and repacking revetment at leaky portions. | 25·00 | 3 4 0 | 81 | 25 0 0 | 4·00 | 100 | 19 | .. | Enhanced rate according to the actual labour that may be required. |
| Seigniorage .. .. .. .. | .. | .. | .. | 6·25 | 0 5 0 | 2 | 2 | .. | |
| Gravel backing .. .. .. .. | 8·5 | 2 0 0 | 17 | 8·50 | 2 0 0 | 17 | .. | .. | |
| Opening bund, examining sides of tunnel 60′ in front and 60′ in rear and reforming bund, etc. | Lump sum. | | 25 | Lump sum. | | 200 | 175 | .. | Too insufficient provision in the original estimate. Current rate has been provided for. |
| Plastering with surki mortar .. .. | 22·50 | 3 10 0 | 82 | 22·50 | 4 4 0 | 96 | 14 | .. | |
| Removing shrubs, etc. .. .. .. | Lump sum. | | 20 | Lump sum. | | 20 | .. | .. | |
| Contingencies .. .. .. .. | .. | .. | .. | 5 per cent. | .. | 64 | 64 | .. | |
| Supervision .. .. .. .. | .. | .. | .. | 2½ per cent. | .. | 36 | 36 | .. | |
| Total .. | .. | .. | 1,149 | .. | .. | 2,230 | 1,083 | 2 | |
| *Constructing a rear cistern 12′ square for High Level sluice.* | | | | | | | | | |
| Burnt stone in surki mortar .. .. | 7·00 | 19 0 0 | 133 | 9·5 | 27 0 0 | 257 | 124 | .. | For enhanced rates please refer to remarks in item No. 1, page 4. Excess quantity since the thickness of walls are increased from 1½′ to 2′. |
| Seigniorage .. .. .. .. | Lump sum. | | 4 | 9·5 | 0 7 6 | 4 | .. | .. | |
| Pointing with surki mortar .. .. | 5·75 | 1 12 0 | 10 | 10·25 | 2 6 0 | 24 | 14 | .. | |
| Concrete in surki mortar .. .. | 1·5 | 9 12 0 | 15 | 1·5 | 15 12 0 | 24 | 9 | .. | |
| Seigniorage .. .. .. .. | .. | .. | .. | .. | 0 5 0 | .. | .. | .. | |
| Slabs, 4″ thick .. .. .. .. | 144 | 0 3 0 | 27 | 144 | 0 5 0 | 45 | 18 | .. | Do. do. |

## Estimate Form--Comparative statement of differences—*cont.*

| Description of work. | Original estimate. | | | Revised estimate. | | | More. | Less. | Explanation of difference. |
|---|---|---|---|---|---|---|---|---|---|
| | Quantity. | Rate. | Amount. | Quantity. | Rate. | Amount. | | | |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| KANDUKUR VIYASASAMUDRAM TANK—*cont.* | | | | | | | | | |
| *Constructing a rear cistern 12′ square for High Level sluice*—cont. | | RS. | RS. | | RS. | RS. | RS. | RS. | |
| Removing shrubs, vegetation, etc. .. | Lump sum. | | 15 | Lump sum. | | 15 | .. | .. | |
| Excavating foundation and benching rock .. | .. | .. | .. | Lump sum. | | 20 | 20 | .. | Omission for provision. |
| Contingencies .. .. .. .. | .. | .. | 138 | .. | .. | 10 | .. | 128 | |
| Supervision .. .. .. .. | .. | .. | 68 | .. | .. | 8 | .. | 60 | |
| Unforeseen works .. .. .. | .. | .. | 80 | .. | .. | 80 | .. | .. | Sanctioned in G.O., No. 263 I, dated 19th June 1909 and registered as No. 45 I of 1909–1910. |
| | .. | .. | 490 | .. | .. | 487 | 185 | 188 | |
| Grand Total, Rs. .. | .. | .. | 3,000 | .. | .. | 5,445<br>3,000 | 2,638<br>193 | 193 | |
| Excess over sanctioned estimate .. .. | .. | .. | .. | .. | .. | 2,445 | 2,445 | .. | |

27*th February* 1909.

C. N. SUBRAMANIA AIYAR,
*Sub-Divisional Officer.*

## III

## Note by the Chief Engineer for Irrigation.

An estimate amounting to Rs 3,000 for improving the low and high level sluices of Kandukur Viyasasamudram tank, Madanapalle taluk, Cuddapah district, was sanctioned in G.O., No. 518 I., dated 14th May 1906.

2. The Superintending Engineer now submits a revised estimate of Rs. 5,320 for the work showing an excess of Rs. 2,320 over the original sanction. It is stated that this excess is chiefly due to—

(*a*) the cost of equilibrium plug valves allowed for the regulation of supply through the sluices as intimated by the Public Works Workshops (inculding railway freight, carriage to work spot and fixing charges) having considerably exceeded the amount originally allowed.

(*b*) Enhanced rates having been allowed for concrete, masonry, etc., owing to the difficulty of getting the work done for the rates allowed in the original estimate, which were generally found low.

(*c*) Provision made in the original estimate for opening the bund and reforming it, excavating foundations, baling, etc., having been found inadequate.

3. On comparing the detailed estimate and comparative statement submitted by the Superintending Engineer, it is found that the provision made in the comparative statement for high level sluice under items (*a*) baling water and forming ring bund and (*b*) opening bund, examining sides of tunnel and reforming bund is less by Rs. 25 and 100 respectively than that provided in the detailed estimate. The figures given in the latter have been taken to be correct and the comparative statement altered accordingly. This has increased the amount of the revised estimate from Rs. 5,320 to Rs. 5,445. The estimate as corrected in this office is recommended for sanction.

4. The probable cost of the equilibrium plug valves should have been ascertained in the first instance from the General Superintendent, Public Works Workshops. It is further noticed that the submission of the revised estimate ought not to have been delayed so long the excess now shown is stated to have been anticipated as early as August 1908.

5. A report on the working of the equilibrium plug valves after they have been in use for a complete season should be submitted in order to ascertain if they are satisfactory.

6. The action of the Superintending Engineer in having authorised the Executive Engineer to complete the work in anticipation of sanction to the revised estimate may be approved.

C. A. SMITH,
*Chief Engineer for Irrigation.*

14*th Jnne* 1909.

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**Order—No. 263 I., dated 19th June 1909.**

The revised estimate amounting to Rs. 5,445 for the Kandukur Viyasasamudram tank, Cuddapah division, is sanctioned in supersession of the estimate sanctioned in G.O., No. 518 I., dated 14th May 1906.

2. This sanction is registered as No. 45 I. of 1909–1910.

3. The attention of the Superintending Engineer is drawn to paragraphs 4, 5 and 6 of the note by the Chief Engineer for Irrigation.

(True **Extract**.)

C. A. SMITH,
*Joint Secretary to Govt., P.W.D.,*
*Irrigation Branch.*

To the Chief Engineer for Irrigation.
,, Superintending Engineer, III Circle, with plans and estimate.
,, Examiner, Public Works Accounts.

# Government of Madras.

PUBLIC WORKS DEPARTMENT.

IRRIGATION.
ACCOUNT.

*Reca.* } 1909. *Enclosures*

*Regd.* *Spare copies*

## G.O., No. 264 I., 19th June 1909.

**Foot-bridge at the Kalingarayan Channel, Coimbatore Division**

An estimate of Rs. 930 for the construction of a —, sanctioned with remarks.

## GOVERNMENT OF MADRAS.

## PUBLIC WORKS DEPARTMENT.

**Irrigation.**
**Account.**

READ—the following papers :—

I

*Letter*—from H. T. KEELING, Esq., Executive Engineer, Coimbatore Division.
*To*—the Superintending Engineer, IV Circle.
*Dated*—the 8th October 1908.
*No.*—712-S.E.

I have the honour to forward herewith three estimates for the construction of bridges at 28/4, 38/1 and 48/6½ to 7 miles of the Kalingarayan channel for Rs. 930, Rs. 670 and Rs. 890, respectively, and to request that sanction of Government may be obtained at an early date so that the works may be carried out during 1908–1909.

2. The Collector of Coimbatore states that bridges at these mileages of the Kalingarayan channel are necessary and that one-half of the estimated cost will be paid by the villagers, while the other half will be met from the Irrigation Cess fund during 1908–1909. The Deputy Collector of Erode has been addressed regarding the recovery of Rs. 1,245, being half the cost of the estimates, from the villagers.

*No.* 246 *I., dated* 23*rd October* 1908.

Copy with estimate forwarded to the Chief Engineer for Irrigation for favour of sanction.

H. O'CONNELL,
*Superintending Engineer, IV Circle.*

II

**Memorandum No. 4414, dated 28th November 1908.**

Forwarded to the Board of Revenue (Revenue Settlement) with a request that it will be so good as to signify its approval to the proposed bridges.

C. A. SMITH,
*Chief Engineer for Irrigation.*

To the Board of Revenue (Revenue Settlement), with plans and estimate in original to be returned.

III

*Letter*—from the Tahsildar of Erode.
*To*—the Deputy Collector of Erode.
*No.*—N. Dis. 3314-Sub. of 1908.

The ryots who have consented to contribute towards half the cost for the construction of bridges at 28/4 and 38/1 miles of the Kalingarayan channel have paid their contribution, viz., Rs. 465 and Rs. 335 respectively, in January 1909 and credited into this taluk sub-treasury. The ryots who consented to contribute for the work at 48/6½ mile now refuse to contribute. The Revenue Inspector has been directed to obtain their written statement to that effect and report. I shall submit the same on its receipt. No bridge need be constructed on the 48th mile now.

---

*Endorsement by M.R.Ry. Sambasiva Aiyar, Deputy Collector, Erode taluk, No. N. Dis.* 4822-*Sub. of* 1908.

Forwarded to the Executive Engineer, Coimbatore Division.

2. As recommended by the Tahsildar of Erode, no bridge need be constructed now at the 48/6½-7 mile of the Kalingarayan channel.

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*Endorsement by H. T. Keeling, Esq., Executive Engineer, Coimbatore Division, dated* 12*th March* 1909, *No.* 141-*S.E.*

Copy forwarded to the Superintending Engineer, IV Circle, for information with a request that sanction be accorded to the estimate for the two first-named bridges.

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*No.* 57-*I.*/410-*C., dated* 15*th March* 1909.

Copy forwarded to the Chief Engineer for Irrigation for favour of obtaining sanction to the estimate for the two first-named bridges submitted with this office No. 246-I of 23rd October 1908.

H. O'CONNELL,
*Superintending Engineer, IV Circle.*

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IV

**Memorandum No. 1060, dated 19th March 1909.**

Copy forwarded to the Board of Revenue (Revenue Settlement) in continuation of this office memorandum No. 4414, dated 28th November 1908.

2. It is requested that an early reply may be sent.

(By order.)

T. W. S. SMYTH,
*Assistant Chief Engineer.*

To the Board of Revenue (Revenue Settlement).

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V

**Proceedings of the Board of Revenue, (R.S. Sur., L.R. and Agri.), Mis. No. 1207, dated 7th April 1909.**

*Read*—the following papers :—

*Memorandum from the Chief Engineer for Irrigation, No.* 4414, *dated* 28*th November* 1908.

*Board's Reference thereon, No.* 3186, *dated* 14*th December* 1908.

Forwarded to the Collector of Coimbatore for report, with reference to G.O., No. 1308, Revenue, dated 11th May 1908, whether the expenditure on the work referred to in the memorandum read above will be a proper charge on the Irrigation Cess fund. It should also be reported whether the ryots holding lands under the channel have been consulted and whether they agree to bear one half of the cost of the work by debit to the Irrigation Cess fund and the other half as a direct contribution by themselves.

---

*Letter*—from the Collector of Coimbatore.

*To*—the Secretary to the Commissioner of Revenue Settlement, Survey, Land Records and Agriculture.

*Dated*—the 31st March 1909.

*No.*—D. Dis. 1113-Rev.

In reply to the Board's Reference No. 3186, dated 14th December 1908, regarding the construction of certain bridges across the Kalingarayan channel, I have the honour to state that the Deputy Collector, Erode, has reported that the bridges are necessary and may be carried out from the Irrigation Cess fund. It is now reported that the ryots who originally proposed the construction of three bridges at 28/4, 38/1 and 48/6½-7 miles have now given their written consent for the construction of the first two bridges alone and have remitted into the treasury half the cost, viz., Rs. 800. They have not given their consent for the third bridge, nor have they contributed one-half of its cost though called upon to do so. Hence I recommend that the estimate for the first two bridges alone may be sanctioned and that the proposal to construct a bridge at 48/6½-7 may be given up. The expenditure is a proper charge on the Irrigation Cess fund.

---

*Resolution—Mis. No.* 1207, *dated* 7*th April* 1909.

The letter from the Collector of Coimbatore read above will be communicated to the Chief Engineer for Irrigation.

2. In the circumstances reported by the Collector, the Board approves the proposal to construct two foot-bridges at 28/4 and 38/1 miles of the Kalingarayan channel, half the cost being met from the Irrigation Cess fund appertaining to that channel.

(True Extract.)

L. D. SWAMIKANNU,
*Secretary.*

To the Chief Engineer for Irrigation with enclosures.
Copy to the Collector of Coimbatore.

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## V

*Letter*—from H. T. KEELING, Esq., Executive Engineer, Coimbatore Division.

*To*—the Superintending Engineer, IV Circle.

*Dated*—the 30th April 1909.

*No.*—251-S.E.

In continuation of this office No. 141-S.E./253, dated 12th March 1909, I have the honour to forward herewith copy of letter, D. Dis. No. 1144/Rev., dated 21st April 1909, received from the Tahsildar of Erode, and to request that you will be good enough to accord early sanction to the estimate of Rs. 930 for the bridge at 28/4 mile of the Kalingarayan channel as half the amount of the estimate has already been recovered from the party concerned. The other bridges proposed may lie over for the present.

2. The estimate for Rs. 1,010 for a bridge at 33/2½ mile of the Kalingarayan channel for which a contribution of Rs. 505 is stated to have been recovered—*vide* Tahsildar's letter—will be forwarded for sanction on receipt from the Collector who has been addressed.

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ENCLOSURES.

*Letter*—from M.R.Ry. E. T. VEDANAYAKAM PILLAI, Avargal, Tahsildar of Erode.

*To*—the Executive Engineer, Coimbatore Division.

*Dated*—the 21st/22nd April 1909.

*No.*—D. Dis. 1144-Rev.

With reference to your No. 739, dated 20th April 1909, informing me that you have requested the Superintending Engineer to sanction the estimates for the first two bridges only, viz., at 28/4 and 38/1 miles, I beg to report as follows.

2. Out of the three estimates for the construction of bridges at 28/4, 38/1 and 48/6½ to 7 miles of the Kalingarayan channel for Rs. 930, Rs. 670 and Rs. 890 respectively referred to in your letter No. 739 said above, I beg to state that Rs. 465 alone, being half the cost of the estimate for the bridge at 28/4, was collected from the ryots concerned and credited into the treasury on 20th January 1909. The contribution from the ryots for the other two estimates for the bridges at 38/1 and 48/6½ to 7 miles could not be collected and credited into treasury as the ryots concerned refused to pay the contribution, though they consented to do so before, as reported, by my predecessor in office, to the Deputy Collector, Erode, in this office D. Dis. No. 1093-Rev. dated 23rd April 1908. But it has been wrongly reported by me, through mistake, to the Deputy Collector, Erode, in this office D. Dis. No. 624-Rev., dated 5th March 1909, that Rs. 335, being half the cost of the estimate for the bridge at 38/1 mile, was collected and credited into the treasury on 7th January 1909. Rs. 335 said to have been collected is the contribution from the ryots for the construction of the bridge at 33/2½ mile of the Kalingarayan channel which was ordered by the Collector to be collected from the ryots concerned in his order, D. Dis No. 283-Rev., dated 19th January 1909. The balance of contribution, viz., Rs. 170, for the same bridge, viz., at 33/2½ mile, was also collected from the ryots and credited into the treasury on 31st March 1909, the total sum being Rs. 505, which is half of the estimate Rs. 1,010.

3. So, I beg to report that the bridges at 38/1 and 48/6½ to 7 miles need not be constructed this year as the ryots have not contributed anything towards their cost and that the bridges at 28/4 and 33/2½ miles may be constructed this year, as the contribution from the ryots was credited into the treasury before the close of the official year 1908–1909.

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*Report to accompany the estimate for constructing bridges at* 28/4, 38/1 *and* 48/6½ *to* 7 *miles of the Kalingarayan channel.*

| | RS. |
|---|---|
| Amount of estimate ... ... ... ... ... ... .. | 2,490 |

The estimate has been prepared on the requisition of the Deputy Collector, Erode, contained in his No. 3044, dated 17th June 1906. It provides for constructing foot-bridges at 28/4 and 38/1 miles and a wheel traffic bridge at 48·6½ to 7 mile of the Kalingarayan channel, but were kept back for lack of funds. The Collector having now stated in his letter No. 2461, dated 20th August 1908, that funds from the Irrigation Cess fund sufficient to meet half the cost of the estimate would be available during 1908–1909, the estimate is now sent up for sanction. The ryots have agreed to pay one-half of the estimate amount.

2. The work will be carried out in accordance with the standard specification of the Public Works Department.

H. T. KEELING,
*Executive Engineer, Coimbatore Division.*

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*No.* 100-*I.*/410-*C.*, *dated* 3*rd May* 1909.

Copy forwarded to the Chief Engineer for Irrigation for very early sanction in continuation of this office No. 57-I./410-C. of 15th March 1909.

H. O'CONNELL,
*Superintending Engineer, IV Circle.*

VII

## Note by the Chief Engineer for Irrigation, dated 20th May 1909.

In the circumstances stated in the Superintending Engineer's last letter read above, the estimate for constructing a foot-bridge at 28/4 mile of the Kalingarayan channel is recommended for sanction. The construction of the bridges proposed at miles 38/1 and 48/6½ may be deferred for the present. The Superintending Engineer may be asked to expedite the submission of the estimate for the bridge proposed to be built at mile 33/2½.

2. It is observed that the nature of soil and sub-soil has not been noted on the plan as required by Circular Memorandum No. 4750-C., dated 16th August 1906. The Superintending Engineer should see that such omissions do not recur.

3. The ryots concerned have paid half the cost of the bridge, and the Board of Revenue has approved of the other half being met from the Irrigation Cess fund.

C. A. SMITH,
*Chief Engineer for Irrigation.*

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**Order—No. 264 I., dated 19th June 1909.**

The following estimate is sanctioned, half the cost of the work being contributed by the ryots concerned and the other half being met from the Irrigation Cess fund :—

Provincial.
Irrigation.
43. Minor Works and Navigation
Class II.—Minor Works for which Capital and Revenue Accounts are kept.
Kalingarayan Channel System.
Revenue Account.
1. Extensions and Improvements.
2. Main Canals and Branches.
G. Bridges.
Constructing a foot-bridge at 28/4 mile.

| | RS. |
|---|---|
| Estimate— | |
| Contribution by the ryots ... ... ... ... ... ... | 465 |
| Irrigation Cess fund ... ... ... ... ... ... ... | 465 |
| Total ... | 930 |

2. This sanction is registered as No. 44 I. of 1909–1910.

3. The attention of the Superintending Engineer, IV Circle, is drawn to paragraphs 1 and 2 of the foregoing note by the Chief Engineer for Irrigation.

(True Extract.)

C. A. SMITH,
*Joint Secy. to Govt., P.W.D.,*
*Irrigation Branch.*

To the Chief Engineer for Irrigation.
,, Superintending Engineer, IV Circle, with plans and estimate.
,, Examiner, Public Works Accounts.
,, Revenue Department (with notes).

# Government of Madras.

## PUBLIC WORKS DEPARTMENT.

IRRIGATION.
ACCOUNT.

| | | | |
|---|---|---|---|
| *Recd.* | 1909. | *Enclosures* | |
| *Reqd.* | | *Spare copies* | |

## G.O., No. 265 I., 21st June 1909.

**Rolla Anantapur tank, Anantapur district**

Sanctioning, with remarks, a revised estimate, amounting to Rs. 21,835, for restoring the —.

GOVERNMENT OF MADRAS.

PUBLIC WORKS DEPARTMENT.

**Irrigation.**
**Account.**

Read—the following papers :—

I

**G.O., No. 90 I., dated 20th February 1907.**

Abstract.—Sanctioning an estimate, amounting to Rs. 11,500, for restoring the Rolla Anantapur tank, Anantapur district.

II

*Letter*—from P. R. Allen, Esq., m.i.c.e., Superintending Engineer, III Circle.
*To*—the Chief Engineer for Irrigation.
*Dated*—Bellary, the 5th April 1909.
*No.*—2263.

I have the honour to forward herewith, for favour of sanction of Government, a revised estimate, amounting to Rs. 21,835, for restoring the Rolla Anantapur tank, Anantapur district, in lieu of that sanctioned in G.O., No. 90 I., dated 20th February 1907.

The reason for the revision is explained in the report accompanying the estimate and in the comparative statement.

Enclosures.

*Report to accompany the revised estimate for restoring Rolla Anantapur tank, Kalyandrug taluk.*

| | RS. |
|---|---|
| Amount of revised estimate ... ... ... ... ... ... | 21,835 |

The estimate has been revised in accordance with Superintending Engineer's Memorandum No. 3452, dated 12th May 1908, communicated with the Executive Engineer's No. 708-A, dated 18th May 1908, and also of all orders, copies of which are herewith attached.

*Situation and source of supply.*—The Rolla Anantapur tank is a ruined one, close to the village of Rolla Anantapur No. 40, Kalyandrug taluk. It is reported that the bund breached about 60 years ago and all the waterspread and the lands under the tank with the exception of 15 acres were classed as poramboke. Fifty acres of the ayacut close to the village have since been irrigated by two spring channels—one from the river Pennér and other from the supply vanka to the tank. In addition to the drainage from its free basin of 16·37 square miles, the tank receives the surplus of three upper tanks having a combined catchment of 57·55 square miles and surplusses into the Pennér river at both the flanks.

*Bund.*—The bund is about 4,000′ long. It is damaged throughout. A large breach exists in the centre of the bund between the escapes. The quantity of the earthwork provided for in the sanctioned estimate is quite inadequate. The increase in this item is due to (1) omission of puddle wall in breach—*vide* Executive Engineer's No. 107-A, dated 26th January 1908;

(2) filling up gaps in front slope of the bund caused by the removal of the existing revetment which has to be repacked; (3) filling up depressions and gullies and also the three scours on the rear slope of bund (as per orders of Executive Engineer); (4) further, in carrying the trial pits to a greater depth, it was found that the subsoil at the site of the breach under the portion of the bund which had already been built consisted of loose sand. This has formed the subject of a correspondence (copy enclosed). As ordered by Superintending Engineer, this new earthwork will be removed and proper foundations provided for the bund. The revised estimate provides for this item which will amount roughly to Rs. 1,000 and increase the estimate accordingly; (5) the earth originally selected for closing the breach was not approved of by Superintending Engineer and a better sort of clay will be used for this purpose. As this clay is only available at some distance from the site of the breach, the rates for earthwork have to be raised considerably on account of the extra lead. For similar reasons the rates for raising the existing bund in places are also increased, gravelly soil only being used for this portion of the work.

*Revetment.*—The sanctioned estimate provides for raising the existing revetment 2½ feet with new stone 1 foot thick, *i.e.*, up to 2 feet above M.W.L. The existing revetment practically throughout is in a dilapidated condition and must also be removed and repacked. Only three-fourths of the stones are fit for repacking and the balance one-fourth must be substituted by new stones. The thickness of revetment at breach site has been increased to 1½ feet; hence the increase in the cost of revetment and a corresponding increase in gravel backing.

*Gravelling.*—This item has been greatly exceeded. The total length of bund for 4,000 feet has to be gravelled at top, in front slope and one yard down the rear slope. The original estimate omitted to provide for a length of 1,300 feet as above. Further, the whole of the revetment, as stated above, will be backed with 6 inches of gravel. At site of breach the bund will be covered with gravel 1 foot thick from toe to toe.

*Scrub jungle.*—No provision has been made in the sanctioned estimate for removing scrub jungle. There are about 100 babul and kanaga trees on the front slope and at breach site. Besides this prickly-pear is found in abundance on bund. Provision has now been made to completely remove all vegetation and to uproot the same.

*Constructing a weir at right flank.*—A small excess has been caused in this item by the removal of the existing old apron which was not provided for in the original estimate.

*Constructing sluice No. 2.*—On executing this work, it was discovered that an old sluice barrel existed at 3 feet below sill of proposed sluice. This was completely opened out and filled in with concrete involving an excess of Rs. 20.

*Constructing a sluice and skin wall at left flank byewash.*—The design for a new weir at left flank originally proposed and sanctioned is not to be carried out (*vide* note left by Mr. Formby—letter No. 90-S.E., dated 22nd January 1908). It has been proposed, with the approval of the Superintending Engineer, to omit the weir and to render the existing roughstone byewash effective by introducing a skin wall in front 170 feet long with crest level at 52·00. The rocky ground beyond this at left side will be formed into a natural ground byewash for a length of 68 feet, thereby providing the necessary waterway to discharge on the whole 2,772 cusecs with a head of 3 feet as per calculations—*vide* Superintending Engineer's Memorandum No. 3452, dated 12th May 1908, communicated with demi-official No. 708-A, dated 18th May 1908. The old sluice (under left flank byewash) which was referred to in sanctioned plan will be carried right through the existing apron for a length of 134 feet. It will also be repaired and put into order.

*Sluice at right flank.*—A sluice having been granted by Superintending Engineer's orders for the spring channel at right flank, provision for this item is made in the revised estimate as well as for a short extension of the bund at the same place to meet the high ground beyond the spring channel. A lump sum of Rs. 50 has been put down in the revised estimate as cost of acquiring a small portion of patta land lying in the breach.

The tank, when restored, will irrigate about 350 acres, yielding a revenue of Rs. 1,050, at the rate of Rs. 3 per acre, which amount, after deducting Rs. 200 for cost of annual maintenance, will leave a net revenue of Rs. 850 to Government. The total outlay is as follows:—

| | RS. |
|---|---|
| Bund ... | 17,350 |
| Weir at right flank ... | 2,100 |
| Sluice No. 2 ... | 1,220 |
| Sluice and skin wall at left flank ... | 1,085 |
| Sluice at right flank ... | 80 |
| Total ... | 21,835 |

Thus the return on the outlay works out to nearly 4 per cent.

P. N. A. Lucas,
*Assistant Engineer.*

21*st February* 1909.

## Estimate Form—Comparative statement of differences.

| Serial number. | Description of work. | Original estimate. | | | Revised estimate. | | | More. | Less. | Explanation of differences. |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Quantity. | Rate. | Amount. | Quantity. | Rate. | Amount. | | | |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
| | *Bund.* | | RS A. P. | RS. | | RS. A. P. | RS. | RS. | RS. | |
| 1 | Earthwork raising the bund including sectioning, watering and tamping. | 796·5 | 4 13 0 | 3,833 | 350·000 | 4 13 0 | 1,684 | .. | 2,149 | This is the actual quantity utilised as per bill for the right half of the breach now closed as per orders of the late Executive Engineer, Mr. Formby and the Sub-Divisional Officer, Mr. M. Power. Copy herewith. |
| | (*a*) Earthwork raising the new bund on the left half of the breach after removing the earth from the newly raised bund on the right half of breach including sectioning, watering and tamping. | .. | .. | .. | 350·000 | 4 0 0 | 1,400 | 1,400 | .. | The newly formed bund is to be removed and relaid as per orders of Executive Engineer in his C. No. 8, dated 16th December 1908. This is the most economical course suggested. Data submitted herewith. |
| | (*b*) Earthwork raising the new bund on the right half and a portion of the left half of breach with clay soil including sectioning, watering and tamping, etc. | .. | .. | .. | 590·000 | 6 0 0 | 3,540 | 3,540 | .. | About half the portion of the breach was now closed, for which 350 units of earth was utilised from the existing ground surface to the top of the bund. Double this quantity is necessary to close the whole breach. The bottom area of the whole bund at breach (400′ × 150′) is to be removed of the entire sand 4′ deep and filled in with good earth as per orders of Executive Engineer in D.O. No. 1144 S.E., dated 19th November 1908. Hence the quantity arrived at is necessary. Detail and data are given. |
| | (*c*) Earthwork raising the existing bund on the left of breach with gravelly soil including sectioning, watering and tamping, etc. | .. | .. | .. | 240·118 | 7 12 0 | 1,861 | 1,861 | .. | Detail and data submitted. Gravelly earth is to be made use of for the raising of the existing bund as per orders of Superintending Engineer. Copy is herewith. |
| | (*d*) Earthwork raising the existing bund on the right of breach with gravelly soil including sectioning, watering and tamping, etc. | .. | .. | .. | 29·200 | 6 10 0 | 193 | 193 | .. | The increase in earth work is due to (1) the omission of puddle wall, (2) the filling of the gap in front slope when the existing revetment was removed and repacked, (3) the filling up of the low places and gullies on the top and slopes of the bund, (4) the filling up of the three scours as instructed by the Executive Engineer, Mr. Formby on the rear slope of the bund, (5) the extension of bund on the right of right weir to meet the high ground as per orders of the present Sub-Divisional Officer. |
| | (*e*) Earthwork raising the existing bund on both sides of breach with clay soil including sectioning, etc. | .. | .. | .. | 55·000 | 3 9 0 | 196 | 196 | .. | This is the actual quantity utilised from the tank bed as per data of the original estimate to strengthen the bund wherever necessary. This is to be removed as per reasons shown in the item (*g*). |
| | (*g*) Removing the earthwork done on the existing tank bund on both the sides of the breach | .. | .. | .. | 55·000 | 2 0 0 | 110 | 110 | .. | This quantity as per actual execution is to be removed as per orders of Superintending Engineer as it is black tank bed silt. Copy is herewith. |
| 2 | Benching and cutting steps in the breach to form thorough earth connection between the old and new works including the removal of ant-hills. | .. | .. | .. | Lump sum. | | 50 | 50 | .. | Removal of ant-hills and cutting steps into the old bund to connect it with the new, are quite essential to ensure good work. |
| 3 | Removing the trees from the very roots, prickly pears, shrubs, etc., at the slopes and top of the bund wherever necessary. | .. | .. | .. | Lump sum. | | 200 | 200 | .. | At front slope and in the breach there are about 100 trees of baboolkanaga, etc., to be removed from the very roots when the revetment works and closing breach are put in hand. Besides the prickly pears are grown in abundance in front and rear slopes of the bund where the earthwork is essential. The breach and the sites of the right weir are also filled in with prickly pears and thorny bushes. Hence the provision is necessary. |

## Estimate Form—Comparative statement of differences—*cont.*

| Serial number. | Description of work. | Original estimate. | | | Revised estimate. | | | More. | Less. | Explanation of Differences. |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Quantity. | Rate. | Amount. | Quantity. | Rate. | Amount. | | | |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
| | *Bund*—cont. | | RS. A. P. | RS. | | RS. A. P. | RS. | RS. | RS. | |
| 4 | Gravelling the top of the bund other than that at the breach including spreading, sectioning, watering and tamping, etc., complete. | 204·00 | 1 8 0 | 306 | Lump sum. | | 30 | 444 (for 4 and 4 (a)) | .. | The revised estimate proposes gravel for the raising of the existing bund. After the completion of the work the top layer requires nicely sectioning, profusely watering and well tamping, to give a neat appearence. Hence lump sum provision is made. |
| | (*a*) Gravelling the top of the bund at breach including spreading, sectioning, watering and tamping. | .. | .. | .. | 480·00 | 1 8 0 | 720 | | .. | This portion of the bund is made of clay soil 1 foot gravel coating is necessary as per recent orders of Superintending Engineer regarding breach closing. |
| 5 | Puddle wall .. .. .. | 805·75 | 1 12 0 | 1,410 | .. | .. | .. | .. | 1,410 | Common earth is to be provided in its place as per Executive Engineer's order No. 107-A., dated 26th January 1908. |
| 6 | Earthwork excavating foundation to puddle wall. | 27·300 | 3 0 0 | 82 | .. | .. | .. | .. | 82 | *Vide* remarks against item No 5. |
| 7 | Clearing sand to hard available stratum at breach, to construct the bund on the firm soil. | .. | .. | .. | 300·000 | 2 2 0 | 638 | 638 | .. | Loose sand in the foundation should be cleared before constructing the bund. Detail herewith. |
| | (*a*) Clearing silt at the site of breach .. | Lump sum. | | 50 | .. | .. | .. | .. | 50 | Not necessary, as sufficient provision is made in the item No. 7. |
| 8 | Baling water .. .. .. | .. | .. | .. | Lump sum. | | 100 | 100 | | To get rid of the spring water during excavation at breach this is necessary. |
| 9 | Removing the old stone revetment and the new stone revetment in front of the new bund on the right half of the breach. | .. | .. | .. | 1046·45 | 0 8 0 | 523 | 523 | .. | The removal of the existing revetment, which is very much displaced, involves additional labour. Hence extra provision is made here. The newly formed bund on the right half of the breach with its revetment is to be removed and relaid —*vide* remarks against item No. 1 (*a*). |
| 10 | Repacking revetment with old stones .. | 183·50 | 1 8 0 | 275 | 920·00 | 1 12 0 | 1,610 | 1,335 | .. | Owing to the complete displacement of the front revetment in most of the places this is repacked as per instructions of the then Executive Engineer Mr. Formby. Extra rate of As. 4 per unit is allowed for repacking revetment with chips as per instructions of Executive Engineer on 28th January 1909. |
| | (*a*) Lead for the old stones .. .. | .. | .. | .. | Lump sum. | | 20 | 20 | .. | Near the breach there is a balance of about 20 units of old stones available for use to the revetment near left flank byewash, where they are to be carted with a lead of 1,000 feet on the average. The big boulders about 10 units scattered throughout the inner toe of the bund left of breach are to be carted to the foundation of revetment at breach as per instructions of Executive Engineer on 28th January 1909. Hence the provision is necessary. |
| 11 | Excavation in clay soil for the foundation of revetment. | .. | .. | .. | 8·500 | 3 8 0 | 31 | 31 | .. | Foundation trench under the revetment was dug out wherever necessary. Detail submitted. |

## Estimate Form—Comparative statement of differences—*cont.*

| Serial number. | Description of work. | Original estimate. Quantity. | Original estimate. Rate. | Original estimate. Amount. | Revised estimate. Quantity. | Revised estimate. Rate. | Revised estimate. Amount. | More. | Less. | Explanation of differences. |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
| | *Bund*—cont. | | RS. A. P. | RS. | | RS. A. P. | RS. | RS. | RS. | |
| 12 | Packing revetment of dry stone with new stones. | 81·50 | 6 0 0 | 489 | 465·00 | 6 0 0 | 2,790 | 2,301 | .. | Detail submitted. |
| 13 | Gravel backing to old and new revetment. | 118·00 | 1 8 0 | 177 | 630·00 | 1 8 0 | 945 | 768 | .. | When the whole revetment was removed it was found the soil behind is clay. Hence gravel backing was provided with 1′ at breach and 6″ elsewhere. Detail herewith. |
| 14 | Wedging interstices in the face of the existing revetment. | Lump sum. | | 200 | .. | .. | .. | .. | 200 | Unnecessary as the whole revetment is repacked. |
| 15 | Contingencies .. .. .. | .. | | 210 | .. | .. | 249 | 39 | .. | In proportion to the increase in the work. |
| 16 | Petty supervision .. .. | .. | .. | 168 | .. | .. | 410 | 242 | .. | Do. do. |
| 17 | Land compensation .. .. .. | .. | .. | .. | Lump sum. | | 50 | 50 | .. | About the centre of the breach there is a patta land to be acquired with a well for which lump sum provision is made in this item. |
| | Total .. | .. | .. | 7,200 | .. | .. | 17,350 | 14,041 | 3,891 | |
| | *Constructing a weir at Right Flank.* | | | | | | | | | |
| 1 | Concrete broken stone in mortar .. | 48·60 | 11 8 0 | 559 | 50·12 | 11 8 0 | 576 | 17 | .. | Due to the filling up of the old sluice barrel below apron in rear. Detail herewith. |
| 2 | Rough stone in mortar, 2nd sort .. | 49·80 | 14 12 0 | 735 | 49·32 | 14 12 0 | 727 | .. | 8 | Found sufficient during execution. |
| 3 | Coping slab 6″ thick .. .. .. | 462 | 0 6 0 | 173 | 527 | 0 6 0 | 198 | 25 | .. | In addition to the body wall and left wings, right wings and returns are also coped. The original estimate omitted to provide for the latter. Hence excess. |
| 4 | Pointing with surki mortar .. .. | 28·30 | 1 8 0 | 42 | 28·30 | 1 10 0 | 46 | 4 | .. | The masonry should be pointed with surki mortar as per orders of the present Sub-Divisional Officer. |
| 5 | Rough stone dry packing with old stones .. | 51·00 | 1 8 0 | 77 | 51 00 | 1 8 0 | 77 | .. | .. | |
| 6 | Gravel backing .. .. .. | 14·55 | 1 8 0 | 22 | 14·55 | 1 8 0 | 22 | | .. | |
| 7 | Earthwork excavating foundation filling in including forming bank. | Lump sum. | | 150 | 60·000 | 4 10 0 | 278 | 128 | .. | The existing weir was extended both ways. It was necessary to remove the bund and excavate for foundation. The soil is very hard gravel. |
| 8 | Excavation of soft rock .. .. .. | .. | .. | .. | 1·051 | 9 5 0 | 10 | 10 | .. | The foundations of the body wall of the weir is soft rock which peals off into layers when saturated with water. Hence it was removed. Detail herewith. |
| 9 | Removing the dry rough stone work .. | .. | .. | .. | 95·70 | 0 8 0 | 48 | 48 | .. | The existing old apron was removed for the construction of weir as per plan. No provision was made in the original estimate. |
| 10 | Clearing out the old sluice removing the covering slabs after breaking them for a length of 15′. | .. | .. | .. | Lump sum. | | 5 | 5 | .. | An old sluice barrel was met with much below the concrete apron. This was fully opened out and refilled with concrete. |
| 11 | Forming a training bank on the left of the weir in continuation of left wing for a length of 50 feet. | .. | .. | .. | Lump sum. | | 25 | 25 | .. | It is necessary to prevent the surplus water from entering into the low ground at the toe of the bund left side. |

## Estimate Form—Comparative statement of differences—*cont.*

| Serial number. | Description of work. | Original estimate. | | | Revised estimate. | | | More. | Less. | Explanation of differences. |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Quantity. | Rate. | Amount. | Quantity. | Rate. | Amount. | | | |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
| | *Constructing a weir at Right Flank*—cont. | | RS. A. P. | RS. | | RS. A. P. | RS. | RS. | RS. | |
| 2 | Clearing the high ground in rear of dry roughstone apron to the level of the same apron and rearranging the stones in hollow places. | .. | .. | .. | Lump sum. | | 30 | 30 | .. | The apron stones scattered in rear of the weir should be thrown in the hollow places and the high ground in rear should be removed to the level of the second apron to prevent scouring action of the water when the tank surpluses. Hence the lump sum provision is made as per instructions of the Executive Engineer on 27th January 1909 on the spot. |
| | Total .. | | .. | 1,758 | .. | .. | 2,042 | 292 | 8 | |
| 13 | Contingencies .. .. .. | .. | .. | 99 | .. | .. | 10 | .. | 89 | The work remaining is very little. Hence this provision is sufficient. |
| 14 | Petty supervision .. .. .. | .. | .. | 43 | .. | .. | 48 | 5 | .. | In proportion to the increase in the work. |
| | Total .. | .. | .. | 1,900 | .. | .. | 2,100 | 297 | 97 | |
| | *Constructing sluice No. 2.* | | | | | | | | | |
| 1 | Concrete broken stone in mortar .. | 18·00 | 11 8 0 | 207 | 21·49 | 11 8 0 | 247 | 40 | .. | An old sluice barrel was met with below 3' of the proposed sill. This was fully opened out and filled in with concrete. The foundation trench was made a little wider to clear out old barrel fully. Hence excess. |
| 2 | Coursed rubble stone in mortar, second sort. | 22·90 | 14 12 0 | 338 | 22·94 | 14 12 0 | 338 | | | |
| 3 | Cut granite stone in mortar .. .. | 208 | 0 12 0 | 156 | 208 | 0 12 0 | 156 | .. | .. | |
| 4 | Pointing with mortar .. .. | 11·50 | 1 8 0 | 17 | 11·50 | 1 8 0 | 17 | .. | .. | |
| 5 | Providing screw gearing shutter, including teakwood beams, rolling freight and carrying to work site. | Lump sum. | | 160 | Lump sum. | | 160 | .. | .. | |
| 6 | Opening bank excavation foundation, filling in including repacking revetment. | Lump sum. | | 200 | 43·398 | 4 10 0 | 200 | .. | .. | As the soil is very hard Rs. 4-10-0 rate is allowed here, detail herewith. |
| 7 | Excavating leading channel in front and rear of sluice and providing revetment, etc. | Lump sum. | | 50 | Lump sum. | | 50 | .. | .. | |
| 8 | Removing the covering stones of the old sluice barrel after breaking them, including the clearence of the barrel for about 50 feet in length. | .. | .. | .. | Lump sum. | | 10 | 10 | .. | Found necessary during execution. |
| 9 | Cutting grooves for the screw gearing shutter in front. | .. | .. | .. | Lump sum. | | 5 | 5 | .. | |
| 10 | Cutting grooves for the shutters in rear cistern. | .. | .. | .. | Lump sum. | | 10 | 10 | .. | It was necessary to cut the grooves in the rear cistern walls to run the shutter as shown in plan. Hence the provision is made. After completion it is now ordered both by the Sub-Divisional officer and Executive Engineer to close one of the two vents in the rear cistern. Hence no shutters are needed. |

## Estimate Form—Comparative statement of differences—*cont.*

| Serial number. | Description of work. | Original estimate. | | | Revised estimate. | | | More. | Less. | Explanation of differences. |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Quantity. | Rate. | Amount. | Quantity. | Rate. | Amount. | | | |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
| | *Constructing sluice No. 2—cont.* | | RS. A. P. | RS. | | RS. A. P. | RS. | RS. | RS. | |
| 11 | Contingencies .. .. .. .. | .. | .. | 52 | .. | .. | 7 | .. | 45 | The work is almost finished ; hence this will be sufficient. |
| 12 | Petty supervision .. .. .. | .. | .. | 10 | .. | .. | 30 | .. | .. | |
| | Total .. | .. | .. | 1,200 | .. | .. | 1,220 | 65 | 45 | |
| | *Constructing a sluice and skin wall in front of the existing apron at Left Flank and lowering the escape.* | | | | | | | | | |
| 1 | Constructing a weir and byewash at left flank. | .. | .. | 1,200 | .. | .. | .. | .. | .. | The original design was altered and it was ordered to repair the existing apron with a skin wall in front—*vide* S.E. No. 3452, dated 12th May 1908. |
| 2 | Earthwork excavating foundation in hard gravelly soil. | .. | .. | .. | 18·022 | 4 10 0 | 83 | 83 | .. | The foundation soil consists of small cubes of stone mixed with hard gravel ; hence schedule rate is given. |
| 3 | Excavation in rocky soil .. .. | .. | .. | .. | 16·320 | 9 5 0 | 152 | 152 | .. | The rocky ground should be cleared to a depth of 3′ on an average. This was approved by Executive Engineer on 28th January 1909. |
| 4 | Concrete broken stone in surki mortar (1 lime, $1\frac{1}{2}$ surki, 1 sand). | .. | .. | .. | 4·14 | 14 0 0 | 58 | 58 | .. | 14 rupees is the rate agreed upon. |
| 5 | Coursed rubble stone in surki mortar .. | .. | .. | .. | 12·00 | 17 0 0 | 204 | 204 | .. | Data submitted. |
| 6 | Burnt stone slab 6″ thick .. .. | .. | .. | .. | 332·06 | 0 12 0 | 249 | 249 | .. | Do. |
| 7 | Pointing with surki mortar .. .. | .. | .. | .. | 8·00 | 1 10 0 | 13 | 13 | .. | Only lump sum provision is made. |
| 8 | Dry roughstone work (old) .. .. | .. | .. | .. | 106·00 | 2 0 0 | 212 | 212 | .. | This includes both removing and repacking. |
| 9 | Removing the prickly-pears, bushes, cutting trees, etc., including removing and re-packing revetment at the roots of the trees cut down and removed. | .. | .. | .. | Lump sum. | | 20 | 20 | .. | |
| 10 | Cutting plug hole, lower vent hole for the plug rod in the guide and platform stones. | .. | .. | .. | Lump sum. | | 10 | 10 | .. | |
| 11 | Removing the existing dry roughstones of the right wing and repacking it including the earthwork for strengthening the same | .. | | .. | Lump sum. | | 25 | 25 | .. | |
| 12 | Providing plug with iron rod, etc., complete. | .. | .. | .. | Lump sum. | | 10 | 10 | .. | |
| | Total .. | .. | .. | 1,200 | .. | .. | 1,036 | .. | .. | |
| 13 | Contingencies .. .. .. | .. | .. | .. | .. | .. | 23 | .. | .. | |
| 14 | Petty supervision .. .. .. | .. | .. | .. | .. | .. | 26 | .. | .. | |
| | Total .. | .. | .. | 1,200 | .. | .. | 1,085 | .. | 115 | |

## Estimate Form—Comparative statement of differences—*cont.*

| Serial number. | Description of work. | Original estimate. Quantity. | Original estimate. Rate. | Original estimate. Amount | Revised estimate. Quantity. | Revised estimate. Rate. | Revised estimate. Amount. | More. | Less. | Explanation of differences. |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
| | *Constructing a sluice to pass the spring channel right of Right weir.* | | | RS. | | RS. A. P. | RS. | | | |
| 1 | Excavating foundation in hard gravelly soil. | .. | .. | .. | ·210 | 4 10 0 | 1 | 1 | .. | This is proposed as per orders of the Superintending Engineer. Copy of the order herewith. |
| 2 | Concrete broken stone in surki mortar .. | .. | .. | .. | 1·65 | 14 0 0 | 23 | 23 | .. | |
| 3 | Coursed rubble stone in surki mortar .. | .. | .. | .. | 1·76 | 17 0 0 | 30 | 30 | .. | |
| 4 | Burnt stone slab 6″ thick .. .. | .. | .. | .. | 29 | 0 12 0 | 22 | 22 | .. | |
| 5 | Pointing with surki mortar .. .. | .. | .. | .. | Lump sum. | | 2 | 2 | .. | |
| 6 | Providing shutter in front and old stone revetment at the sides. | .. | .. | .. | Lump sum. | | 2 | 2 | .. | |
| | Total .. | .. | .. | .. | .. | .. | 80 | 80 | .. | |
| | Abstract of the foregoing estimates. | | | | | | | | | |
| 1 | Bund .. .. .. .. .. | .. | .. | 7,200 | .. | .. | 17,350 | 14,041 | 3,891 | |
| 2 | Constructing a weir at right flank .. | .. | .. | 1,900 | .. | .. | 2,100 | 297 | 97 | |
| 3 | Constructing sluice No. 2 .. .. | .. | .. | 1,200 | .. | .. | 1,220 | 65 | 45 | |
| 4 | Constructing a sluice and skin wall in front of the existing apron at left flank and lowering the escape. | .. | .. | 1,200 | .. | .. | 1,085 | .. | 115 | |
| 5 | Constructing a sluice to pass the spring channel right of Right weir. | .. | .. | .. | .. | .. | 80 | 80 | .. | |
| | Total .. | .. | .. | 11,500 | .. | .. | 21,835 | 14,483 | 4,148 | |
| | Amount of original estimate sanctioned —*vide* C.R. No. 85 of 1906-1907 | .. | .. | .. | .. | .. | 11,500 | 4,148 | .. | |
| | Excess required for sanction .. | .. | .. | .. | .. | .. | 10,335 | 10,335 | .. | |

*8th March* 1908.

L. L. Wickham,
*Executive Engineer, Bellary Division.*

## III

*Telegram*—from the Chief Engineer for Irrigation.
*To*—the Superintending Engineer, III Circle, Bellary.
*Dated*—the 21st April 1909.

Send correspondence and instructions issued in connection with alterations in executing Rolla Anantapur tank.

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## IV

*Letter*—from P. R. Allen, Esq., M.I.C.E., Superintending Engineer, III Circle.
*To*—the Chief Engineer for Irrigation.
*Dated*—Bellary, the 29th April 1909.
*No.*—2686.

In reference to your telegram, dated 21st April 1909, regarding the revised estimate for restoring Rolla Anantapur tank, I have the honour to submit the correspondence and instructions issued from this office in connection with the alterations and deviations proposed with the restoration of the tank.

The Executive Engineer has been directed to submit without delay copies of instructions issued by him and the orders issued by the inspecting officers on the work site.

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Enclosures.

*Letter*—from the Overseer, Kalyandrug.
*To*—the Sub-Divisional officer, Anantapur.
*Dated*—the 18th December 1907.
*No.*—725.

I beg to report that I inspected Rolla Anantapur tank on 11th December 1907 and checked all the items sanctioned in the estimate at the site with the contractor and bring to your notice the following discrepancies :—

(1) No provision is made in the sanctioned estimate for removing the prickly-pear bushes, small trees such as babool, kanaga, etc., over the bund and at breach site where earthwork is necessary.

Clearance is very considerable in front revetment which is all dilapidated. It seems about Rs. 100 is necessary if it is carried out departmentally.

As clearance does not admit of correct measurement this is considered the simplest way of dealing with the matter to avoid altercations with the contractor.

(2) The estimate proposes to raise the existing revetment from C.S. No. 4 to C.S. No. 11 for about 3′ and to construct the front revetment at breach site 1′ thickness. Nothing else.

I see the whole revetment is slipped down. It requires thorough removal and repacking. If a single stone is touched the whole thing will come down. The stones are very poor. A third of the stones is hardly available for use. For the safety of the tank thorough revision of the revetment work is necessary.

Awaiting early inspection.

No earthwork and revetment can be done until the clearance is settled.

(3) The estimate provides old stones for the masonry in the left flank weir. The rate is cut down accordingly. Whereas old stones for the masonry are not available at all ; early orders are solicited.

(4) Lastly I beg to inform you that the puddle wall is proposed for the breach. According to the recent orders it seems objectionable.

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*No.* 5458, *dated* 23*rd December* 1907.

Submitted to the Executive Engineer, Bellary division, for information and favour of early orders. The contractor has been ordered to do the following works :—

| | RS. |
|---|---|
| Constructing a weir and byewash at left flank ... ... ... | 1,200 |
| Constructing a weir at right flank ... ... ... ... ... | 1,900 |
| Constructing a sluice No. 2 ... ... ... ... ... ... | 1,200 |
| Total ... | 4,300 |

I will start earthwork on receipt of orders as to whether I may clear prickly-pear, etc., departmentally. There is no provision for this in estimate. As the Superintending Engineer disapproves of closing breaches with puddle wall, I request orders as to whether the breach may be closed with ordinary earth and covered over with gravel—*vide* sketch.

Orders are requested regarding the revision of estimate to provide for above items and also for building new revetments as explained by Overseer. I did not see this tank when I visited Kambadur as I had not the estimate.

M. Power,
*Sub-Divisional officer.*

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*No.* 3 *S.E.*, *dated* 3*rd January* 1908.

True copies forwarded to the Superintending Engineer for information and orders. In the meanwhile before I can inspect I have given orders to do all necessary clearance departmentally to close the breach according to the orders given by you for Jakkalacheruvu and as per Sub-Divisional officer's sketch to remove and repack any of the revetment badly displaced and to revise the estimate on the above lines. I request your approval.

R. W. Formby,
*Executive Engineer, Bellary Division.*

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*Letter*—from P. R. Allen, Esq., M.I.C.E., Superintending Engineer, III Circle.
*To*—the Executive Engineer, Bellary division.
*Dated*—the 16th January 1908.
*No.*—418.

[*Reference*—his No. 3-S.E., dated 3rd January 1908.]

Has the honour to point out that the Government Order sanctioning the restoration of the Rolla Anantapur tank was communicated to him early in April 1907.

Early in October last funds were allotted for the prosecution of the work.

The Superintending Engineer now (January 1908) receives a report, dated 18th December 1907, in which it is pointed out that many deviations will be required from the sanctioned estimate, and that no work has, as yet, been done.

Practically speaking, six months has already been lost. How this has occurred it is not fully understood but he should report in detail to this office. Presumably, the sanction was communicated to the Sub-Divisional officer, he has had nine months in which to inspect and report on the tank, but apparently he has not done this ; he must explain his supineness in this matter. I now receive a report from the section officer only which, of course, being unsubstantiated by the Sub-Divisional officer is useless.

The contractor also petitions against the section officer. So far as I can ascertain, the section officer has not set out for the contractor such work as it is possible to do. The Sub-Divisional officer seems to have taken absolutely no step in the matter at all.

So far as information reaches me, the contractor has done no work ; it should be reported how this is and whether it is his fault or no.

The Executive Engineer himself does not seem to have taken any interest at all in the tank or busied himself about making any arrangement at all ; he will explain how it is that this has occurred.

The Superintending Engineer considers that he could reasonably have expected that the deficiencies in the plans and estimates, if they exist, should have been brought to his notice so that they could have been rectified before October. He is also of the opinion that he could have expected that such arrangements should have been made for the prosecution of the work as would have ensured its being put in hand directly funds were allotted. In fact, the work should have been well in hand by now but it is not started.

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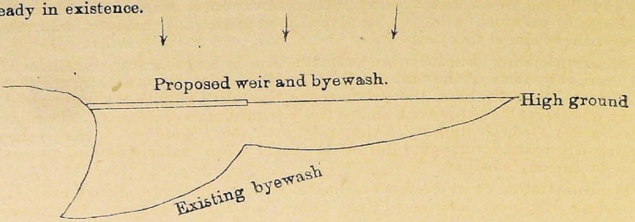
*Letter*—from R. W. Formby, Esq., Executive Engineer, Bellary Division.
*To*—the Superintending Engineer, III Circle.
*Dated*—the 20th January 1908.
*No*—90 S.E.

I have the honour to report that I have carefully examined Rolla tank work with the estimate and to submit the following report.

To begin with the left flank.

A combined weir and byewash is proposed in place of a thoroughly sound and well-packed byewash already in existence.




This new weir and byewash, is waste of money, and quite unnecessary, and moreover the stone for it is said to be available at site, which it is not, considering that the masons in this part of the country know nothing about random rubble work. The stone in existing byewash is said to be available for use in the revetment to be executed at site of breach. This may be true but the stone has been in position for 70 years about, and is so closely wedged in, and is so large, that it would not pay to remove it, for the breach revetment. As regards the earthwork, from left flank to the breach site, the estimate allows for 89 units odd, but there are three hollows, one made by a cart-track, one by cattle, and one by scour, for which earthwork to the extent of 82 units odd is necessary, to say nothing of the earthwork required to raise the bund in places, and to strengthen it in others.

As regards the revetment no allowance at all is made in the estimate for repacking the displaced revetment. From the left flank, the revetment as far as 1,600 feet is in fairly good order, but requires repairs to the extent of 10 units of repacking.

From 1,600 feet to 1,850 feet the revetment is in worse order, and at least one-third should be repacked.

From 1,850 feet to 2,470 feet, the revetment has been undermined in rear, and has fallen to such an extent that it must all be repacked.

From 3,000 feet to 3,400 feet (right of breach) at least 100 units out of 325 units about must be repacked. The bund on the right of the breach is of gravel and requires very slight repair.

As regards the breach, which is 500 feet broad, at least 300 feet can be closed at once without any danger of its again being washed away and orders have been given to this effect. There is so much work to be done in repairing revetments, etc., that the breach cannot be entirely closed this year. I request that you will issue orders, that the repairs to revetment may be started at once, as per revised estimate which is under preparation and also that the left flank weir and byewash need not be built, on my recommendation to this effect.

The estimate was signed by Colonel Baddeley in 1901, and since then, apparently, a lot of prickly-pear has grown on the bund. This has to be removed, but there is no provision for it in the estimate.

A lump sum of Rs. 50 is allowed for silt clearance in the breach, but the sandy bed is 6′ deep and 150′ wide and water is met with after 2′, so that there will be 4′ clearance in water, beside much baling.

The estimate provides for a puddle wall for the breach, but this will be closed with soil of a clayey nature which makes the puddle wall unnecessary.

Very early orders are requested.

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*Letter*—from P. R. Allen, Esq., M.I.C.E., Superintending Engineer, III Circle.
*To*—the Executive Engineer, Bellary Division.
*Dated*—the 27th January 1908.
*No.*—648.

[*Reference*—his No. 90 S.E., dated 20th January 1908.]

Has the honour to acknowledge the receipt of his report on the Rolla Anantapur tank. The report is clear and concise and will enable the Superintending Engineer to issue orders at once.

2. As regards the weir the Executive Engineer's proposals, generally, are approved, but the Executive Engineer must submit at an early date the usual large scale survey and sections of the existing weir together with the Hydraulic data for the tank. This information in all probability, is available amongst the sanctioned plans and sections ; if so such may be sent ; if not, it must be obtained and compiled and sent to the Superintending Engineer as early as feasible.

3. Such earthwork must be done as is necessary to bring the bund up to the projected section ; even if such amount is in excess of that provided in the sanctioned estimate.

4. Such revetment must be done as is necessary to thoroughly protect the bund of the tank up to the level proposed, even if the provision is in excess of that in the sanctioned estimate.

5. As regards the breach, the Superintending Engineer does not fully understand the proposals of the Executive Engineer ; he states :—

"As regards the breach, which is 500 feet broad, at least 300 feet can be closed at once without any danger of its again being washed away and orders have been given to that effect. There is so much work to be done in repairing revetments, etc., that the breach cannot be entirely closed this year".

The Superintending Engineer understands that by keeping the remainder of the breach 200 feet open, the safety of the tank, and safety of the work to be done in the 300 feet, will be ensured. Such being the case, the orders of the Executive Engineer are approved. The omission of the puddle wall is approved under the circumstances explained. Possibly some little baling can be obviated by digging a channel down the nullah bed to enable the water to run off. Baling is usually interrupted during the night when water rises and undoes much of the good done by the day's baling.

6. The compilation of the revised estimate, so far as possible, should proceed. When the Superintending Engineer has issued final orders relative to the weir, such estimate can be completed.

7. Relative to the road way crossing the bund, a ramp should be made to facilitate traffic if necessary, the gradient being 1 in 15. Such ramp may be made at right angles to the bund or parallel to the bund. The latter alternative, which merely requires a certain widening of the bund, is preferable.

8. The names of the officers and subordinates concerned in the compilation of the estimate should be reported.

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*Letter*—from A. C. Langston, Esq., Executive Engineer, Bellary Division.
*To*—the Superintending Engineer, III Circle.
*Dated*—Bellary, the 30th April 1908.
*No.*—510-S.E.

With reference to your No. 648, dated 27th January 1908, I have the honour to enclose one section sheet and one original survey of the byewash at the left flank of Rolla Anantapur tank together with a calculation sheet giving the discharge from catchment area and how this was proposed to be disposed of as per sanctioned estimate.

2. Mr. Formby in his letter No. 90-S.E., dated 20th January 1908, brought to notice that the construction of a new weir would be waste of money especially as the site chosen was lower than the existing byewash.

3. What is proposed to be done in the revised estimate is to omit the weir, build a skin wall in front of the existing byewash 170 feet long cutting down the crest of it to + 52 and also the ground beyond this to form a ground escape for a length of 68 to provide the necessary waterway to discharge 2,772 cusecs as per calculation sheet No. 2.

4. I quite approve of this proposal, although it may seem somewhat risky to run 3 feet of water over such a byewash still the old apron is said to be very well bedded and the soil is gravel and sub-soil hard gravel and therefore I don't think there is much to fear.

5. On receipt of your approval the preparation of revised estimate will be proceeded with; the last paragraph of your letter will be replied to later on.

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*Letter*—from P. R. Allen, Esq., M.I.C.E., Superintending Engineer, III Circle.
*To*—the Executive Engineer, Bellary.
*Dated*—the 12th May 1908.
*No.*—3452.

Has the honour to inform him that his proposals are approved, but the skin wall need not be broader than 18 inches and it would appear that a total depth of 3 feet would suffice if it is to be built on gravel. In any case it would appear that this is all that is necessary and that no foundation of concrete is required to it. The masonry must, of course, be in surki mortar.

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*Letter*—from A. C. Langston, Esq., Executive Engineer, Bellary Division.
*To*—the Superintending Engineer, III Circle.
*Dated*—Bellary, the 8th May 1908.
*No.*—540-S.E.

In reply to the last paragraph of your letter No. 648, dated 27th January 1908, I have the honour to inform you that the estimate was prepared when Mr. Handcock was Executive Engineer, M.R.Ry. R. Vythiyanatha Aiyar Sub-Divisional Officer and V. R. Venkatrama Aiyar Overseer.

*No.* 3688, *dated* 20*th May* 1908.

This must be recorded but a note must be made of it when sending up for sanction the revised estimate.

P. R. Allen,
*Superintending Engineer, III Circle.*

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*Letter*—from P. R. Allen, Esq., M.I.C.E., Superintending Engineer, III Circle.
*To*—the Executive Engineer, Bellary.
*Dated*—the 5th September 1908.
*No.*—6346.

Has the honour to forward herewith, in original, a letter from the contractor of the Rolla-Anantapur tank for careful enquiry and report. He will at once see that it will be necessary for him to proceed to the Rolla Anantapur tank as soon as possible, and make such arrangements as are necessary for the better conduct of the work. The Superintending Engineer has written certain orders in the order book of the work which should receive attention.

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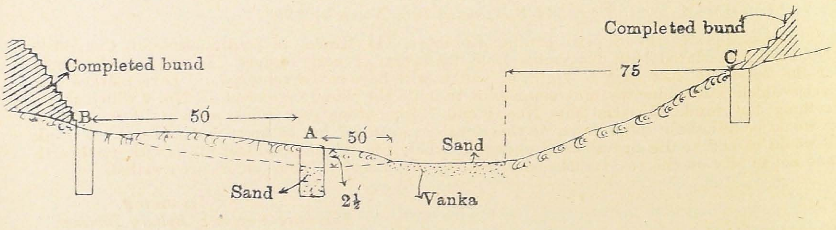
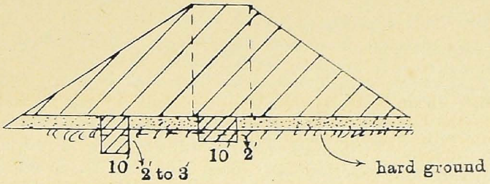
*Letter*—from J. M. Lacey, Esq., Executive Engineer, Bellary Division.
*To*—the Superintending Engineer, III Circle, Bellary.
*Dated*—the 10th November 1908.
*No.*—1095-S.E.

I have the honour to inform you that I inspected the Rolla-Anantapur tank on 27th October 1908. The breach across the vanka of stream has not been closed yet, and will be taken in hand after the rains are over. The estimate provides for removing the sand from the vanka over the whole area of the bund to hard ground, which is reported to be at a depth of 6′. In order to ascertain what the nature of the soil was on either side of the vanka I had pits dug as per sketch below and the results are shown in the sketch.




A pit at *A* which appeared to be hard ground gave sand at a depth of 2½′ which showed it to be only silt hardened over the original bed of the vanka. To find out how far this extended I ordered pits at *B* and *C* to be excavated and a section to be sent showing the nature of soil met with. This has not been received as yet and will be forwarded on its arrival. If the bed of the vanka extends to any great extent on either side, to remove the whole of this to hard ground would be a very expensive matter. The depth of water at the vanka at F. T. L. is about 25′ but the depth will decrease towards the sides and I imagine a thickness of 5′ to 6′ of hardened silt over the original bed of the vanka will prevent any percolation through and under the bund. However to be on the safe side I would propose instead of removing the sand over the whole area of the bund to hard ground, two trenches to be excavated 10′ in width right across to hard ground from the two ends of the already completed bund. This I think would prevent

any percolation under the bund and would effect a considerable saving. The sketch below will explain how I would place the trenches. The trenches will be filled up with the same soil as




the bund. I request your orders on the matter.

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*Letter*—from P. N. A. Lucas, Esq., Anantapur Sub-Divisional Officer.
*To*—the Executive Engineer, Bellary Division.
*Dated*—the 16th November 1908.
*No.*—1496/E.

I have the honour to forward herewith sections of trial pits taken at different places at the site of the breach to Rolla Anantapur and request that you will kindly submit these to the Superintending Engineer for early orders as the revised estimate cannot be prepared until I have received definite instructions about the removal or otherwise of the layer of sand under the bund. It will be seen from the sections that this layer extends to a considerable distance under the portion of bund which has been recently put up. The stratum is probably about 6 feet thick at the present bed of the nalla and gradually thins down to nothing opposite trial pit No. 7 in the plan.

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*No.* 1144-*S.E.*, *dated* 19*th November* 1908.

Forwarded to the Superintending Engineer, III Circle, in continuation of this office No. 1095 S.E., dated 10th November 1908, for favour of early orders. In any case the whole of the bund 230 feet long to right of vanka will have to be removed. I have marked the levels which I consider we may commence to build the bund on except in No. 4 which shows nothing but sand. In trial pits Nos. 6 and 7 lime stone rock is met with and I don't think it would be advisable to go down to this level in section 7 but to keep just above it. I think it would be best to dig out all sand under the whole site of the bund and fill in with good earth and not to rely on the two trenches proposed by Mr. Lacey. Your orders are awaited.

A. C. Langston,
*Executive Engineer, Bellary Division.*

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*Letter*—from P. R. Allen, Esq., M.I.C.E., Superintending Engineer, III Circle.
*To*—the Executive Engineer, Bellary.
*Dated*—the 7th December 1908.
*No.*—8438.

[*Reference.*—His. No. 1144-S.E., dated 19th November 1908.]

Has the honour to fully agree with the Executive Engineer and requests that he will make arrangements accordingly. The Superintending Engineer is the more fully persuaded of the suitability of the Executive Engineer's recommendations from the fact that the part marked new bund is not laid as it should be. The Superintending Engineer made several borings into it on the day of his visit and found that the clods had not been properly broken up. To

make a really good job of this breach closing the Executive Engineer's proposals should be fully carried out, and when the bund is relaid, the earth must be well broken up and consolidated. So far as that portion of the bund is concerned which will be situated over trial pit 40·4, it will be necessary to excavate to the bottom of the sand and found the bund on the best available strata met with below the sand.

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V

*Letter*—from P. R. Allen, Esq., M.I.C.E., Superintending Engineer, III Circle.
*To*—the Chief Engineer for Irrigation.
*Dated*—Camp Horsleykonda, the 10th May 1909.
*No.*—2882.

In continuation of this office letter No. 2686, dated 29th April 1909, and as promised therein, I have the honour to forward herewith copies of orders issued by the Executive Engineer, Bellary Division, No. 565-A., dated 18th April 1908, and No. 1224-A., dated 29th August 1908, in connection with the alterations and deviations in the sanctioned estimate for the Rolla Anantapur tank, also a copy of notes of inspection of the work by Mr. J. M. Lacey, Executive Engineer.

2. The order book containing orders issued by inspecting officers at the work site is also sent herewith.

3. It is requested that all the orders and documents sent in original may kindly be returned.

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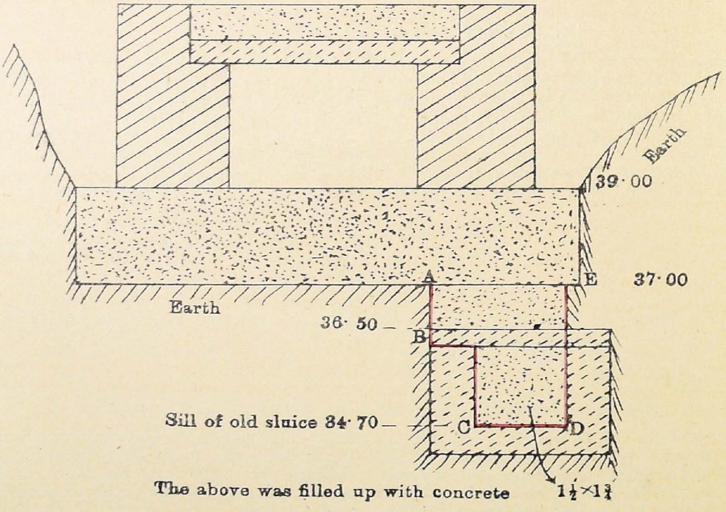
Enclosures.

*Letter*—from M.R.Ry. R. Lakshminarayana Row, Overseer, Kalyandrug.
*To*—the Sub-Divisional Officer, Anantapur.
*Dated*—the 20th March 1908.
*No.*—128.

I beg to report that the bund for the construction of new sluice was cut open and the founds were opened out for the laying of concrete. I found the tunnel of the old sluice running throughout the length of the foundation which is 70 feet.




The above was filled up with concrete

The above was filled up with concrete.

The portion A B C D E shown in red ink is the extra concrete. The covering stones were removed after breaking them.

In front of the sluice 3½ feet concrete is laid under head wall as per estimate.

There was another old sluice underneath the concrete apron which was also filled up with concrete in right flank weir. The above extra works cost 5½ units of concrete and the labour for breaking the covering slabs which is about Rs. 20.

These works were carried out in anticipation of your sanction, as they are urgent.

I request your approval.

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*No.* 7503, *dated* 22*nd March* 1908.

Approved. Necessary provision should be made in revised estimate.

M. Power,
*Sub-Divisional Officer.*

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*No.* 137, *dated* 26*th March* 1908.

Noted and resubmitted.

B. Lakshinarayana Rao,
*Overseer.*

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*No.* 545, *dated* 13*th April* 1908.

Submitted to the Executive Engineer for information and favour of approval. The hollow in the new sluice excavation had to be filled in with concrete.

M. Power,
*Sub-Divisional Officer.*

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*No.* 565-*A.*, *dated* 18*th April* 1908.

Approved.

A. C. Langston,
*Executive Engineer.*

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*Memorandum*—from A. C. Langston, Esq., Executive Engineer, Bellary Division.
*To*—the Sub-Divisional Officer, Anantapur.
*Dated*—the 29th August 1908.
*No.*—1224-A.

*Rolla Anantapur tank.*

With reference to the above, has the honour to request he will communicate any orders passed by the Superintending Engineer on the work.

It appears that the earth work is bad, tank bed silt having been used and clods unbroken. It is believed that the old bund is formed of gravel and gravel only should be used. Also the earth in the portion of the breach being closed is being thrown on sand which will not do. The sand should be removed and the site trenched.

A detailed report should be submitted on the present state of the work.

*Note.*

Copies of the following numbers received from the Superintending Engineer containing orders about the execution of the work of the tank have been communicated to the Sub-Divisional Officer with this office numbers quoted against them :—

Superintending Engineer's No. 648, dated 27th January 1908, communicated to the Sub-Divisional Officer with No. 160-a., dated 30th January 1908.

| | | | |
|---|---|---|---|
| No. 3452, dated | 12th May 1908 | No. 708-A., dated | 18th May 1908. |
| No. 6346 ,, | 5th September 1908 | No. 1437-A. ,, | 8th October 1908. |
| No. 8438 ,, | 7th December ,, | No. 1582-a. ,, | 21st December 1908. |

*Inspection notes of J. M. Lacey, Esq., Executive Engineer, Bellary Division, for the months of October and November.*

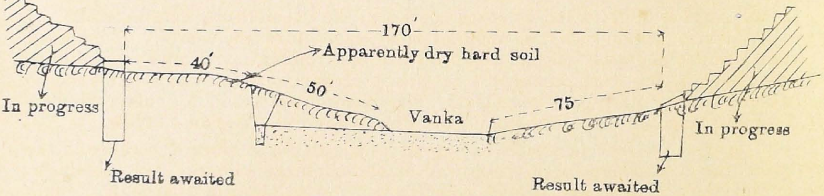
* * * * *

*27th October 1908—Rolla Anantapur tank—Ruined tank now being restored.*—The ryots want a sluice in the right flank for their spring channel which is below M.W.L. of the tank and the Superintending Engineer has sanctioned the same. Provision to be made for this in the revised estimate. The sill to be 6″ below the correct bed level of the present channel to allow for small silting and the vent area to be the mean area of the water way of the channel as there will be little or no head.

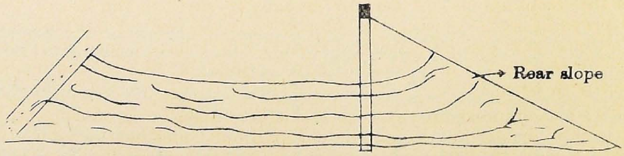
*Weir right flank.*—Revetment below the right wing not to correct slope but may stand the surface must be properly wedged. Pointing weir crest all very bad and crumbling must be re-done with surki mortar and kept well watered. No payment at all to be made for this pointing. There is a crack in the body wall near left flank. Apparently at the place where the foundations change from hard soil to clay. I do not consider that it is dangerous. It should be grouted up well with surki mortar and the crack carefully pointed. Revetment in rear of left wing built wrong and must come down and rebuilt according to the plan and surface well wedged.

*Sluice.*—Completed but barrel not long enough for the original section of the bund, and the cistern is not clear of the same. The side vent will not be of much use and ryots can take water from the middle vent and divide it after it gets clear of the tank bund. A little revetment may be provided on either side of the cistern.

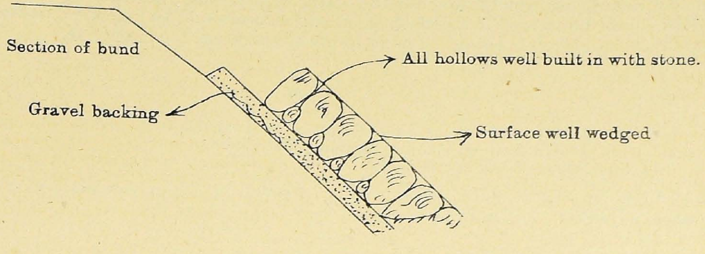
Closing the breach in progress the rate for this work requires revision on account of the additional lead and instructions for the same were given. The rate will work out to about Rs. 6–8–0 against Rs. 4–14–0 sanctioned in the estimate. The actual vanka crossing has not been started yet and the work will be put in hand when the rains are over. The vanka is sand but hard soil is reported to be met with about 6′ below and the estimate provides for removing the sand over this area. To find how far the sand extended under the top silt which appeared to be dry hard ground pits are being sunk as per sketch below and the result of the same is awaited ; when this section is received it will be sent to the Superintending Engineer for orders.




Earth work in progress—good and being watered and trampled, the earth is being carried by buffaloes. In making the bund the earth should be brought up from the bottom to the full width and the width not increased by throwing earth over the side. Work should progress as per sketch.



Revetment work not very good and it will be better to allow the earth of the bund to consolidate before the revetment is started. All hollows should be filled up with stone and not gravel and rubbish. The gravel backing should be well in advance of the revetment as per sketch.




*Rough stone by-wash left flank.*—Plan for cutting the same down and providing a sluice and skin wall, sent to Superintending Engineer for approval. After which the work can be started.

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## VI

*Letter*—from P. R. Allen, Esq., m.i.c.e., Superintending Engineer, III Circle.
*To*—the Chief Engineer for Irrigation.
*Dated*—Camp, Horsleykonda, the 21st May 1909.
*No.*—3148.

(*Reference.*—This office No. 2882, dated 10th May 1909, anent Rolla Anantapur tank.)

I have the honour to inform you, in continuation of the above, that work on the Rolla Anantapur tank has been stopped pending your orders on the revised estimate.

2. In August 1908, when I visited the work, the expenditure was Rs. 4,525. I regret to have to inform you that much of this expenditure was waste. It included a certain amount of breach-closing and you will see from my notes and the notes in the order book of the work, since sent to you, that the work on this closing was so badly done that, as closing, it is useless. The officers responsible for this work were Mr. Formby, Executive Engineer, and Mr. Power, the Sub-divisional officer.

3. I am not inclined to attach any great blame to these officers, because in the first place, the Anantapur sub-division was much too large a charge for one officer, and I think that in any case it was courting disaster to place in charge of the sub-division an officer of Mr. Power's standing. Whilst this work was being done the section officer was detached from other works to attend to the closing of the breach of the Bhairavasamudram tank. Again, Mr. Power's attention was taken up by the closure of the breach of the Tumpara black tank, a tank near Anantapur, and the restoration of Jakkula cheruvu. On the whole the staff did very well considering and I really cannot blame them for this bad work.

4. The expenditure amounts to Rs. 8,744. I regret to say that some slight further waste has occurred for which Mr. Lucas is responsible, and I am not able to hold him free from blame. A certain amount of earth in the bed of the nallah was removed preparatory to closing the breach. As the rest of the tank was not ready for this closure, this was premature. Besides this I have issued very definite orders about closing breaches which should have guided Mr. Lucas had he made himself conversant with them.

5. I wish to impress on you that I consider this an unpromising project, because the tank is supplied by its own catchment area only and has no connection with any river or other source. The catchment areas in this part of the country are poor at most and the yield is most uncertain on account of the fickle character of the yearly

rains. At the same time the country is exceedingly poor and the people are badly off, and the occasional year of bounty which is afforded when the tank actually fills undoubtedly helps them enormously, not only by direct cultivation under the tank, but by raising the spring level of the water in the wells. So far as I can ascertain, the tank can be expected to fill once in three years and to fail once in three years, the other years being poor. This is the best character I can give it.

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## VII

*Telegram*—from the Chief Engineer for Irrigation.
*To*—the Superintending Engineer, III Circle.
*Dated*—the 3rd June 1909.

Your No. 3148, dated 21st ultimo. Work on Rolla Anantapur tank may be proceeded with. Order follows.

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## VIII

### Note by the Chief Engineer for Irrigation.

The papers read above relate to the restoration of the Rolla Anantapur tank, Kalyandrug taluk, Anantapur district.

2. An estimate, amounting to Rs. 11,500, for restoring the tank was sanctioned in G.O., No. 90 I., dated 20th February 1907, and the work was put in hand. The estimate provided for—

| | | RS. |
|---|---|---|
| (i) | Closing breach in the tank and raising its bund ... ... ... | 7,200 |
| (ii) | Constructing a surplus weir at right flank and a combined weir and byewash at left flank ... ... .. ... ... | 3,100 |
| (iii) | Constructing sluice No. 2 ... ... ... ... ... ... | 1,200 |
| | Total ... | 11,500 |

3. The Superintending Engineer now submits a revised estimate for Rs. 21,-35, showing an excess of Rs. 10,335 over the original sanction. This has almost entirely occurred under item (i) and is due to—

(*a*) Extra earth work found necessary during execution owing to the removal of sand to a depth of about 5 feet at the breached site and filling in the same with selected earth, as well as to the necessity for strengthening the portions of the bund which had badly eroded since the preparation of the original estimate.

(*b*) Increased rates having been allowed for earth work as selected earth required for closing the breach and for raising the bund had to be brought from a longer distance, the earth within the originally-estimated lead being found unsuitable for the purpose.

(*c*) Extra expenditure incurred on account of tank-bed silt utilised for the bund but subsequently ordered to be removed and for clearing sand at the breach, baling water, removing prickly-pear and other trees along the bund, provision for which was not made in the original estimate.

(*d*) Removing and repacking the whole of the existing revetment with $\frac{1}{4}$ new stones found necessary, instead of removing and repacking with old stones only a small portion of the old revetment as originally proposed, and also to the increased thickness from 1 foot to $1\frac{1}{2}$ feet allowed to the new revetment at the breach as well as to the necessity for extra gravel backing provided on account of changes in the original proposal under revetment.

A sluice at the end of the right flank estimated to cost Rs. 80 has been provided to pass the spring channel supply at the request of the ryots as it is found necessary.

4. The Superintending Engineer now reports that the work has been stopped pending orders on the revised estimate and that the project is an unpromising one as the tank can be expected to fill only once in three years and to fail once in three years.

But it is not clear why this fact was not brought to notice in August 1908 when he inspected the work up to which time only an expenditure of Rs. 4,525 had been incurred.

5. It is observed that earth work carried out up to date has not been carefully executed and that the preparation of the revised estimate was also very much delayed. From the records submitted by the Superintending Engineer, it is further noticed that, although the necessity for revision was brought to the notice of the Sub-Divisional officer so far back as December 1907 and the estimate was said to be under revision in January 1908, the revised estimate has not been submitted until April 1909; but no explanation of the delay has been given and this is very unsatisfactory.

6. The revenue anticipated according to the statement furnished by the Collector and printed in page 7 of G.O., No. 90 I., dated 20th February 1907, is Rs. 603, which gives a return of 1·55 per cent. on the proposed outlay of Rs. 21,835 as against 3·15 per cent. on the estimate originally sanctioned after making the usual deduction for maintenance charges at As. 12 per acre in both cases.

7. As storage works, whatever their magnitude, are of the utmost advantage to the people in the Ceded districts and as an expenditure of Rs. 8,744 has already been incurred on the work in question, it seems desirable to complete it and the Superintending Engineer has been informed accordingly by wire.

8. The question of the responsibility of the officers concerned for the bad work done and the delay in the submission of the revised estimate will be dealt with separately. In the meanwhile, the revised estimate is recommended for sanction.

14*th June* 1909.

C. A. Smith,
*Chief Engineer for Irrigation.*

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**Order—No. 265 I., dated 21st June 1909.**

The revised estimate, amounting to Rs. 21,835, for restoring the Rolla Anantapur tank, Anantapur division, is sanctioned in lieu of the original estimate of Rs. 11,500 sanctioned in G.O., No. 90 I., dated 20th February 1907.

2. This sanction is registered as No. 46 I. of 1909–1910.

3. The attention of the Superintending Engineer is drawn to paragaphs 4 and 5 of the note by the Chief Engineer for Irrigation.

4. The Chief Engineer, Public Works Department, will take action in regard to the question of the responsibility of the officers concerned referred to in paragraph 8 of the foregoing note.

(True Extract.)

C. A. Smith,
*Joint Secy. to Govt., P.W.D.,*
*Irrigation Branch.*

To the Chief Engineer for Irrigation.
,, Superintending Engineer, III Circle, with plans and estimate and papers.
,, Examiner, Public Works Accounts.
,, Revenue Department.
,, Chief Engineer, Public Works Department, with copy of notes.

# Government of Madras.

## PUBLIC WORKS DEPARTMENT

IRRIGATION.
ACCOUNT.

| | | |
|---|---|---|
| *Recd.* | 1909. | *Enclosures* |
| *Regd.* | | *Spare copies* |

## G.O., Nos. 266, 267 I., 22nd June 1909.

**Regulator shutters at Peranai Head Works, Madura Division**

Approving an estimate, amounting to Rs. 17,220, for altering the existing gearing arrangements of — and forwarding for early sanction a copy of the Proceedings together with the plan and estimate for the work.

GOVERNMENT OF MADRAS.

PUBLIC WORKS DEPARTMENT.

**Irrigation.**
**Account.**

READ—the following papers:—

I

**Inspection Notes of the Chief Engineer for Irrigation of the Periyar system from 8th to 19th February 1909. (G.O., No. 117 I., dated 12th March 1909.)**

*Peranai head works.*—The gearings of the regulator shutters were reported some time ago to be working unsatisfactorily even after the original shafts had been replaced by stronger ones. Accordingly, further improvements have been made to the last two spans of the right bank of the river, which appear to be satisfactory. These improvements consist of a stronger rolled beam carrying the pedestals supporting the shaft and an increase in the number of pedestals from three to five.

Stronger rolled joists have also been fitted at the top of the roller paths to carry the winches and the gearing of the latter has also been changed so as to do away with the extra pedestal on the pier at the end of the shaft. All that now remains to be done to these spans, is the provision of steel joists across the piers, in order to transfer the weight which is now carried by the roller path channel iron to the masonry of the piers. When this is done, the whole arrangement is expected to be more rigid than in the original design.

It is also proposed to replace the Admiralty pattern chains by which the shutters and counter-weights are suspended by bicycle pattern chains which experience has shown to be more suitable, owing to the fact that the former are not true to gauge and do not therefore work smoothly with the sprocket wheels. An estimate has been prepared for Rs. 13,000 for effecting similar improvements to the above, to all the spans, and this should be sent up for sanction as soon as possible so as to enable the work to be carried out during the coming closure.

* * * * *

II

*Letter*—from H. E. CLERK, Esq., Superintending Engineer, VI Circle.
*To*—the Chief Engineer for Irrigation.
*Dated*—Trichinopoly, the 7th May 1909.
*No.*—375 C.E.

As called for in your inspection notes communicated to me with G.O., No. 117 I., dated 12th March 1909, and with reference to the correspondence ending with your Memorandum No. 1291, dated 5th April 1909, I have the honour to forward herewith for your approval and sanction of Government an estimate, amounting to Rs. 14,000, for the proposed alterations to the gearing arrangement of the shutters of the regulator at the head works at Peranai. As explained in the report the alterations consist in putting in deeper beams and shorter pedestals to support the horizontal shafts and in substituting bicycle pattern chains for those of the Admiralty pattern now in use.

2. The report attached to the estimate explains the necessity for and the details of the works proposed.

3. The work will be completed before the end of March 1910.

4. The Executive Engineer has been asked to report the cost of the existing arrangements and see if under Public Works Code paragraph 1921 the whole estimate may be sanctioned under 42. Major Works—Working Expenses.

The rates entered in the estimate are fair and the estimate is recommended for very early sanction.

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ENCLOSURES.

*Report to accompany the estimate for the proposed alterations to the gearing arrangements of the Regulator shutters at Peranai Head Works, Periyár System.*

| | RS. |
|---|---|
| Amount of estimate ... ... ... ... ... ... ... | 14,000 |

*The work is one called for in the Chief Engineer's (Irrigation) inspection notes of February* 1909.—The winches and gearing by means of which the Smart's gates of the Peranai regulator are worked have never been satisfactory.

In March 1906 during the first visit of the undersigned to Peranai it was found that the horizontal shafts which hoisted the gates had been bent at the ends. Mr. Basket, the General Foreman of the Madras Public Works Department Workshops, was sent to examine the regulator. He recommended that the existing 3″ diameter shafts be replaced by new 4¼″ diameter shafts and he also recommended that the single 12″ deep girders which supported the horizontal shafts be changed for 16″ deep girders. These alterations were carried out, but the gates did not yet work well. It was then found that the gearing and shafts had not originally been built true with the gates. This latter defect was remedied; the gates worked better, but they still shook the masonry of the piers.

Finally the General Superintendent of the Public Works Workshops recommended that double girders be used to support the shafts. These double girders would be supported on stiff channels 16″ deep instead of the old 6″ deep channels originally used.

He also recommended that bicycle pattern chains be used instead of the old Admiralty pattern chains. These recommendations were adopted and two spans of the regulator were altered accordingly. The cost of altering two spans was charged to the construction estimate "Remodelling the head works at Peranai—estimate Rs. 4,07,814 sanctioned in G.O., No. 814 I., "dated 26th July 1906, and Superintending Engineer's register No. 162 of 1906–07." That estimate has now been closed. As the new arrangements are very satisfactory it is proposed to adopt them for the eight remaining spans of the regulator.

The 16″ channels and rolled steel beams are available at site. New pedestals and new bicycle pattern chains alone will be required. Their cost has been fixed by the General Superintendent, Public Works Workshops. The cost of the labour required for replacing the gearing has been taken from actual figures already obtained from the alterations made to two of the gates.

The data for the masonry work are appended.

The descriptions of details are given in the plans themselves of which there are two sets accompanying. Plates A, B and C refer to the gearing arrangements as now proposed; L, D, E and F to those as existing. Plate G, is the sanctioned plan for remodelling the head works at Peranai in G.O., No. 814 I., dated 26th July 1906.

R. DECHAZAL,
*Executive Engineer, Madura Division.*

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*Letter*—from the General Superintendent, Public Works Workshops.
*To*—the Executive Engineer, Madura Division.
*Dated*—the 4th December 1908.
*No.*—10/39 M. D. R.

With reference to your No. 1947 M., dated 23rd November 1908, I have the honour to inform you that the estimated cost of new pedestals on the double girders and new sprocket wheels for each span will be about Rs. 550, and that of providing new bicycle pattern chain for each span will be about Rs. 500.

As regards the cost of pulling down and reerecting the gearing and fixing double girders 16″ made up channels and cross girders for 8 spans, I think you are in a better position to estimate the same as it depends on the labour available at work site, etc., and one span has moreover been put up by you very recently.

## III

*Letter*—from M. BROWN, Esq., Executive Engineer, Madura Division.
*To*—the Superintending Engineer, VI Circle, Trichinopoly.
*Dated*—the 28th May 1909.
*No.*—540 S.E.

With reference to your letter No. 2179, dated 4th/7th May 1909, I have the honour to state that it is difficult to arrive at the actual cost of the existing gearing arrangements now proposed to be altered, at the regulator works at Peranai, as the figures were adjusted from those given by the General Superintendent, Public Works Workshops, at different times. However, the approximate cost of the arrangement now proposed to be altered may be taken as Rs. 9,000 including all charges.

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*No*. 462 *C.E.*, *dated* 8*th June* 1909.

Communicated to the Chief Engineer for Irrigation, for information with reference to paragraph 4 of this office letter No. 375, dated 7th May 1909.

H. E. CLERK,
*Superintending Engineer, VI Circle.*

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## IV

**Note by the Chief Engineer for Irrigation.**

The estimate received from the Superintending Engineer, VI Circle, with his above letter may be approved and forwarded to the Government of India for sanction, with reference to paragraph 1919 v (*a*) of the Public Works Department Code.

2. The Superintending Engineer reports that the approximate original cost of the old work is Rs. 9,000, which may be written back from the Capital to the Revenue Account of the Periyár system on receipt of sanction of the Supreme Government to the above estimate.

C. A. SMITH,
*Chief Engineer for Irrigation.*

14*th June* 1909.

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**Order—No. 266 I., dated 22nd June 1909.**

The following estimate is approved :—

Imperial.
49. Capital.
I. Works.
1. Head Works.
C. Works.
Altering the existing gearing arrangements of shutters at Peranai Regulator.
Unremunerative Work.

| | RS. |
|---|---|
| Estimate— | |
| I. Works ... ... ... ... ... ... ... ... | 14,000 |
| II. Establishment ... ... ... ... ... ... ... | 3,220 |
| Total ... | 17,220 |

2. Ordered that a copy of these Proceedings, together with the plan and estimate for the work, be forwarded to the Government of India with a request that early sanction thereto may be accorded.

[Here enter No. 267 I., dated 22nd June 1909.]

(True Extract.)

C. A. SMITH,
*Joint Secy. to Govt., P. W. D.,*
*Irrigation Branch.*

To the Chief Engineer for Irrigation.
" Superintending Engineer, VI Circle.
" Examiner, Public Works Accounts.

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**Endorsement—No. 267 I., dated 22nd June 1909.**

Forwarded.

(By Order.)

C. A. SMITH,
*Joint Secy. to Govt., P. W. D.,*
*Irrigation Branch.*

# Government of Madras.

## PUBLIC WORKS DEPARTMENT.

IRRIGATION.
ACCOUNT.

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## G.O., No. 268 I., 22nd June 1909.

**Investigation of the Periyar-Pambiyar Scheme, Madura Division.**

**An estimate of Rs. 6,441 for work done on the — during 1908–1909, sanctioned with remarks.**

GOVERNMENT OF MADRAS.

PUBLIC WORKS DEPARTMENT.

**Irrigation.**
**Account.**

Read—the following papers :—

I

**Memorandum No. 1828, dated 13th May 1908.**

The Superintending Engineer, VI Circle, is requested to submit an estimate of the cost of the Pambiyar-Periyár Investigation conducted under the orders of Mr. S. B. Murray, Executive Engineer, during 1908–1909, distinguishing between "Works", Special Tools and Plant, Establishment, etc.

2. Mr. Murray was finally relieved in that party on the afternoon of the 1st instant.

(By Order.)

T. W. S. Smyth,
*Asst. Chief Engineer for Irrigation.*

To the Superintending Engineer, VI Circle.

II

**No. 2578, dated 9th July 1908.**

The Superintending Engineer is requested to expedite the estimate of the cost of the Pambiyar-Periyár Investigation, called for in this office memorandum No. 1828, dated 13th May 1908.

(By Order.)

T. W. S. Smyth,
*Asst. Chief Engineer for Irrigation.*

To the Superintending Engineer, VI Circle.

III

*Letter*—from J. H. Medlicott, Esq., Superintending Engineer, VI Circle.
*To*—the Chief Engineer for Irrigation.
*Dated*—Trichinopoly, the 19th August 1908.
*No.*—461-C.E.

With reference to your memorandum No. 1828, dated 13th May 1908, I have the honour to forward herewith an estimate amounting to Rs. 8,900 for work done and paid for under the orders of Mr. S. B. Murray in connection with the Pambiyar-Periyár Investigation until the 1st May of this year, when he was relieved of the charge of the Investigation.

## IV

### No. 3226, dated 7th September 1908.

For favour of verification of outlay incurred. If there are any items relating to salary and allowances audited, but not paid, they may also be included.

The passage money paid to Mr. Milner does not appear to be a legitimate charge against the project.

(By Order.)

T. W. S. SMYTH,
*Asst. Chief Engineer for Irrigation.*

To the Examiner, Public Works Accounts.

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## V

*Letter*—from Mr. A. L. WRIGHT, Examiner, Public Works Accounts.
*To*—the Chief Engineer for Irrigation.
*Dated*—the 29th September 1908.
*No.*—281-C.

Herewith a statement of probable expenditure on the Periyár-Pambiyar Investigation project during 1908–1909 so far as is known :—

| | RS. | A. | P. | |
|---|---|---|---|---|
| Works ... ... | 528 | 15 | 8 | Includes a write-back of about Rs. 2,000 on account of tools returned to Public Works Stores in July 1908. |
| Establishment | 6,166 | 15 | 7 | ... |
| Tools and plant ... | 1,254 | 9 | 6 | Represents value of tools returned to Public Works Stores in July 1908. |

2. With reference to paragraph 2 of your office-note, the Executive Engineer, Madura Division, will be instructed to write back to "Provincial Establishment" the sum of Rs. 605 representing Mr. Milner's passage money to Europe and also his salary for the period 23rd to 30th April 1908, viz. Rs. 160, as he was relieved of the investigation work on the afternoon of 22nd April 1908.

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## VI

### No. 3837, dated 20th October 1908.

[*Reference.*—Letter No. 461-C.E., dated 19th August 1908, from the Superintending Engineer, VI Circle.]

The undersigned has the honour to forward copy of Examiner's No. 281-C., dated 29th September 1908, from which it will be seen that the probable expenditure on "Works" excluding the write-back of Rs. 2,000 on account of tools returned to the Public Works Stores is Rs. 2,529, while the provision made by the Superintending Engineer in the estimate therefor amounts only to Rs. 2,310.

2. Expenditure appears to have been incurred under tools and plant, but the estimate makes no provision for that item.

3. It is not clear why the write-back on account of the value of the tools returned to the Public Works Stores should affect the expenditure on "Works" as the remarks in the statement furnished by the Examiner would seem to show.

4. The attention of the Superintending Engineer is drawn to paragraph 2 of the Examiner's note and he is requested to carry out the adjustment accordingly.

5. The estimate is returned for revision and very early resubmission.

(By Order.)

T. W. S. SMYTH,
*Asst. Chief Engineer for Irrigation.*

To the Superintending Engineer, VI Circle.

## VII

*Letter*—from H. E. CLERK, Esq., Superintending Engineer, VI Circle.
*To*—the Chief Engineer for Irrigation.
*Dated*—Trichinopoly, the 11th March 1909.
*No.*—209-C.E.

With reference to your Memorandum No. 3837, dated 20th October 1908, returning with remarks for revision the estimate for the work done and paid for during the current year under the orders of Mr. S. B. Murray in connection with the Periyár-Pambiyar Investigation, I have the honour to state as follows :—

*Paragraph* 1 *of the memorandum.*—You point out that the probable expenditure on "Works" as reported by the Examiner, Public Works Accounts, is Rs. 2,529 while the provision made under this head in the estimate submitted by my predecessor amounts to only Rs. 2,310. The explanation for the difference is that the Examiner's figure includes not only the outlay incurred and paid for up to 1st May 1908—the date of closing the investigation by Mr. Murray, but also the expenditure subsequently incurred in connection with the establishment employed in registering gauge readings—while the figure furnished in this office estimate referred to above, provided only for the actual "Works" expenditure incurred up to 1st May, as required by your memorandum No. 1828, dated 13th May 1908.

*Paragraphs* 2 *and* 3 *of the memorandum.*—Attention is invited to the Executive Engineer's explanation in paragraphs 2 and 3 of his letter No. 70-S.E., dated 18th January 1909 (copy enclosed).

*Paragraph* 4 *of the memorandum.*—The adjustment referred to has since been carried out by the Executive Engineer.

*Paragraph* 5 *of the memorandum.*—A revised estimate to cover the charges actually incurred up to 1st May 1908 under I. Works, II. Establishment and III. Special Tools and Plant, is herewith submitted for sanction. In this estimate the book adjustments carried out, subsequent to the date of closing the investigation, in connection with the outlay under tools and plant, have been taken into account.

2. In this connection and with reference to the concluding sentence of paragraph 1 of the Executive Engineer's letter forwarded herewith, I would point out that a provision of Rs. 2,280 to cover the charges of the establishment engaged in registering gauge readings has been made in the estimate submitted with this office No. 622-C.E., dated 3rd November 1908, for constructing a gauge house for the automatic recorder obtained from the Coimbatore Division.

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### ENCLOSURE.

*Letter*—from A. R. DECHAZAL, Esq., Executive Engineer, Madura Division.
*To*—the Superintending Engineer, VI Circle.
*Dated*—the 18th January 1909.
*No.*—70-S.E.

With reference to your No. 4338, dated 27th October 1908, I have the honour to report as follows :—

1. With my No. 603-S.E., dated 20th July 1908, two estimates—one for Rs. 8,900 comprising of works, outlay Rs. 2,310 and establishment charges Rs. 6,590 for work actually done and paid under the orders of Mr. Murray up to date of closing of the investigation, viz. 1st May 1908, and another for Rs. 2,000 for establishment required for registering gauge readings thereafter, *i.e.*, during the remainder of the year—were sent, from which it will be observed that the provision made in estimate for works is Rs. (2,310 + 2,000) or 4,310 and not 2,310. Against this amount, viz. Rs. 4,310, the whole of the expenditure incurred prior to 1st May 1908 and thereafter was debited. The fact of there being a second estimate of Rs. 2,000 to cover the works outlay during the remainder of the year does not appear to have been known to the Examiner which accounts for the discrepancy brought to notice by that officer. It may, however, be mentioned that in sanctioning the two estimates referred to above, the latter, viz. the estimate of Rs. 2,000 for taking gauge readings may be held distinct from the former, the expenditure pertaining to it will be exhibited accordingly on receipt of sanction thereto.

2. No provision was made in the estimate for expenditure incurred under Tools and Plant as the debit on account, as subsequently been cleared by credit of the value of tools returned to Public Works Stores.

3. The tools obtained for the investigation were partly charged to "Works" and partly to "Special tools and plant". Pending verification of the amount debited to "Works" and that charged to "Special tools and plant" up to date of their transfer, the value of the whole lot of tools returned to Public Works Stores was provisionally credited to "Works" and necessary write-back has been made in accounts for August 1908.

4. The adjustment referred to, paragraph 2 of Examiner's office note, viz., the write-back of passage money paid to Mr. Milner and of his salary from 23rd to 30th April 1908 to Provincial establishment has since been carried out and a revised estimate is accordingly submitted for favour of necessary sanction.

---

### VIII

### Ref. C. No. 423, dated 25th May 1909.

Forwarded to the Examiner, Public Works Accounts, for verification of the actuals shewn in the revised estimate received from the Superintending Engineer.

(By Order.)

T. W. S. SMYTH,
*Asst. Chief Engineer for Irrigation.*

To the Examiner, Public Works Accounts.

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### IX

### No. 180 C., dated 12th June 1909, dated 17th June 1909.

If the charges debited to "Works" from 1st May 1908 to 31st March 1909, aggregating Rs. 2,358, are to be written back to a separate estimate, the provision of Rs. 312 under "Works" and of Rs. 6,129 under "Establishment" in the revised estimate will be sufficient to cover the expenditure incurred.

2. As regards Tools and Plant the entry of Rs. 1,255, represents only the transactions during 1908–1909, viz., the write-back in July 1908 of Rs. 1,254–9–6 debited to this head in 1907–1908. There has been no debit to this head to end of March 1909.

F. P. B. WOOD,
*Examiner of Public Works Accounts.*

To the Chief Engineer for Irrigation.

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### X

### Note by the Chief Engineer for Irrigation, dated 17th June 1909.

The estimate received from the Superintending Engineer, VI Circle, with his last letter quoted above for work done in connection with the investigation of the Periyár-Pambiyar Scheme during 1908–1909 is recommended for sanction.

2. With reference to the concluding portion of paragraph 2 of the Superintending Engineer's letter it may be noted that separate orders have been passed on the estimate for gauging operations therein referred to.

3. As regards the write-back of Rs. 1,255 shown under "Tools and Plant" in the estimate, the attention of the Superintending Engineer may be drawn to paragraph 2 of the Examiner's above office note. The *minus* figure shown by the Superintending Engineer has been deleted, thus raising the total amount of the estimate from Rs. 5,186 to Rs. 6,441.

No. 180 C., dated 12th June 1909.

C. A. SMITH,
*Chief Engineer for Irrigation.*

**Order—No. 268 I., dated 22nd June 1909.**

The following estimate is sanctioned :—

Provincial.

Irrigation.

43. Minor Works and Navigation.

Class IV (*a*) Minor Works for which Capital and Revenue accounts are not kept.

Original Works.

Madura Division.

Investigation of the Periyár-Pambiyar scheme.

| | RS. |
|---|---|
| Estimate— | |
| Works ... ... ... ... ... ... ... ... ... | 312 |
| Special Establishment ... ... ... ... ... ... ... | 6,129 |
| Total ... | 6,441 |

2. This sanction is registered as No. 43 I. of 1909-1910.

3. The attention of the Superintending Engineer is drawn to paragraphs 2 and 3 of the foregoing note.

(True Extract.)

C. A. SMITH,
*Joint Secy. to Govt., P.W.D.,*
*Irrigation Branch.*

To the Chief Engineer for Irrigation.
" Superintending Engineer, VI Circle, with estimate.
" Examiner, Public Works Accounts.

# Government of Madras.

## PUBLIC WORKS DEPARTMENT.

IRRIGATION.

*Recd.* } 1909. *Enclosures*

*Regd.* *Spare copies*

## G.O., No. 269 I., 22nd June 1909.

**Inspection bungalow at Kalavai, North Arcot district**

Disapproving, with remarks, the proposal for the construction of an —.

GOVERNMENT OF MADRAS.

# PUBLIC WORKS DEPARTMENT.

## Irrigation.

**READ—the following papers:—**

I

*Letter*—from H. O'CONNELL, Esq., Superintending Engineer, IV Circle.
*To*—the Chief Engineer for Irrigation.
*Dated*—Coimbatore, the 24th March 1908.
*No.*—79-I.

I have the honour to forward herewith for sanction of Government an estimate, amounting to Rs. 4,900, for constructing an inspection bungalow with out-houses at Kalavai in the Arcot taluk, North Arcot district.

2. Kalavai is an important place where the want of a bungalow is much felt by officers of the Public Works Department. As regards officers of the other departments, a copy of letter No. 376 of 7th March 1908, from the Collector of North Arcot is enclosed.

ENCLOSURE.

*Letter*—from S. P. RICE, Esq., I.C.S., Collector and District Magistrate, North Arcot.
*To*—the Superintending Engineer, IV Circle.
*Dated*—the 7th March 1908.
*No.*—376/D. Eng.

With reference to your letter No. 234-M., dated the 29th February 1908, I have the honour to state that the projected inspection bungalow at Kalavai will be useful to a few officers, such as the Collector, Sub-Collector, Assistant Superintendent of Police, etc., but that they will not go there very often.

II

### Memorandum No. 1517, dated 9th April 1908.

[*Reference.*—Letter No. 79 I., dated 24th March 1908, from the Superintending Engineer, IV Circle.]

The Superintending Engineer is informed that, in view of the fact that the Collector considers that officers of other departments will seldom use the bungalow, the undersigned is unable to recommend Government to sanction its construction, unless the Superintending Engineer can show that the number and importance of the works in the vicinity warrant its construction from Irrigation funds. It is noticed that there is a small-one roomed bungalow in charge of the Local Fund department within a few miles of Kalavai.

2. The estimate received, with the reference quoted above, is herewith returned.

(By Order.)

T. W. S. SMYTH,
*Under Secretary to Government.*

To the Superintending Engineer, IV Circle,
with three plans and estimate.

III

*Letter*—from C. W. WOOD, Esq., A.M.I.C.E., Executive Engineer, North Arcot Division.
*To*—the Superintending Engineer, IV Circle.
*Dated*—the 14th July 1908.
*No*—357 S.E.

[*Reference.*—No. 221-N.A., of 11th April 1908.]

In resubmitting the estimate for a bungalow at Kalavai I have the honour to state that I have consulted the following District officers :—

the District Forest-officer,
the Assistant Commissioner of Salt and Abkári,
the Acting Head Assistant Collector, and
the District Superintendent of Police,

and they are unanimous in considering that the location of a bungalow at Kalavai will much facilitate their inspection. I submit a tracing from irrigation map showing that it is a most convenient centre from which to inspect many works of the Pálár system.

It is also a convenient halting place in a march from Arcot to Arni. I have no hesitation in recommending its construction.

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*No.* 165 *I*/70 *N., dated* 28*th July* 1908.

Forwarded to the Chief Engineer for Irrigation with enclosures with reference to his Memorandum No. 1517, dated 9th April 1908. An inspection bungalow at Kalavai would, in my opinion, be very useful.

(By Order.)

H. O'CONNELL,
*Superintending Engineer, IV Circle.*

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**Order—No. 269 I., dated 22nd June 1909.**

In March 1908 the Superintending Engineer, IV Circle, submitted for sanction plans and estimate, amounting to Rs. 4,900, for the construction of an inspection bungalow at Kalavai in Arcot taluk, North Arcot district. The Collector approved the estimate, but stated that the bungalow would be useful only to a few officials and that they would not go there very often.

2. In memorandum No. 1517, dated 9th April 1908, it was pointed out to the Superintending Engineer that there was already a small one-roomed bungalow in charge of the Local Fund department within a few miles of Kalavai and that the proposed bungalow could not be sanctioned unless the number and importance of public works in the neighbourhood justified its construction.

3. The Superintending Engineer, in reply, forwarded a letter from Executive Engineer, Mr. Wood, stating that the officers of the other departments unanimously considered that the bungalow would much facilitate their inspection. It was also urged that Kalavai would be a convenient centre for the inspection of the works of the Pálár Anicut system. Mr. O'Connell was of opinion that the bungalow would be very useful.

4. After full consideration of the question the Government are of opinion that no case has been made out for the construction of the proposed bungalow. The small one-roomed bungalow referred to in paragraph 2 is only 4 miles off across country. Besides, inspection at this place may well be carried on with tents and there should be no difficulty in getting good sites for pitching them as the country is quite dry. The plans and estimate received from the Superintending Engineer will accordingly be returned to him.

5. Under G.O., No. 978 W., dated 20th May 1905, the Superintending Engineer should have obtained the administrative sanction of Government before the preparation of detailed plans and estimate was undertaken.

(True Extract.)

C. A. SMITH,
*Joint Secretary to Govt., P.W.D.,*
*Irrigation Branch.*

To the Chief Engineer for Irrigation.
,, Superintending Engineer, IV Circle,
with plans and estimate.
,, Examiner, Public Works Accounts.
,, Revenue Department.

# Government of Madras.

## PUBLIC WORKS DEPARTMENT.

IRRIGATION.

| | | |
|---|---|---|
| *Recd.* | 1909. | *Enclosures* |
| *Regd.* | | *Spare copies* |

## G.O., No. 270 I., 23rd June 1909.

**Padugais in the Tanjore district**

Stating that — can be thrown open for grazing purposes on condition that persons desirous of grazing their cattle should deposit the cost of fencing off the padugais for the protection of nanal plantations.

## GOVERNMENT OF MADRAS.

## PUBLIC WORKS DEPARTMENT.

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### Irrigation.

READ—the following papers :—

I

**G.O., No. 222 I., dated 14th May 1907.**

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II

**Reference from the Board of Revenue (R.S., Sur., L.R. and Agri.), No. 783, dated 5th April 1909.**

*Read*—the following paper :—

*Letter*—from J. P. BEDFOOD, Esq., Collector of Tanjore.
*To*—the Secretary to the Commissioner of Revenue Settlement, Survey, Land Records and Agriculture.
*Dated*—the 9th March 1909.
*No.*—R.C. 1483-G.R. of 1908.

I have the honour to submit the following question for the orders of the Board.

2. The insufficiency of pasture lands in this district was the subject of two deputations on the occasion of His Excellency the Governor's visit to this district last year.

The deputations took exception to the practice of leasing out river padugais and urged that such lands should be thrown open for pasturage.

3. The Executive Engineer, Cauvery division, was consulted and stated that he would have no objection to allowing cattle grazing on padugais, if the conservancy plantations along the river margins could be effectively protected without a prohibitive outlay, and that he would formulate proposals for the reservation of strongly enclosed grazing grounds at intervals down the river margins. He considered that one feature of such a scheme would be the imposition of a prohibitive fee for trespass on the adjacent unenclosed padugais. I consulted my Divisional Officers on the point and they were unanimously of opinion that, in the interests of the ryots, padugai lands could and should be thrown open for pasturage, subject to such restrictions as might be found necessary for river conservancy. Now the Executive Engineer has altered his view and considers, after discussion with the Superintending Engineer, that the small extent of padugai lands available (about 120 acres) hardly warrants the further consideration of the proposal. The small extent of padugais is hardly a final argument, as any additional grazing is better than none ; nor do I know the grounds on which the Superintending Engineer and the Executive Engineer have arrived at an estimate of 120 acres, nor why Mr. Morin should have changed his mind. His original opinion was expressed after many years' experience of the district. There is undoubtedly a vague but strong impression prevalent in this district that the Public Works Department are inclined to over-estimate difficulties in this matter and to adopt the policy which gives them least trouble. On the other hand river conservancy is paramount. Had the Executive Engineer, from first to

last, been definitely of opinion that the proposal was hopeless, I should not have pressed it, as it is clearly safer to rely on professional knowledge rather than on ignorance, even assuming more or less prejudice on both sides. On the other hand, I have at present two conflicting opinions by the Public Works Department, neither of them supported by any very convincing reasons. It seems to me that the matter deserves a full and thorough enquiry as the grazing question in Tanjore has reached an acute stage, and the amount of unoccupied land remaining in the district, which could be utilised for grazing, is very little. I therefore submit the matter for the orders of the Board. Copies of the notes put up on the subject on the occasion of His Excellency's visit and of the whole of the subsequent correspondence are enclosed.

4. Should a decision be eventually arrived at in favour of allowing cattle grazing on padugais, I would deprecate the charge of any fees for the purpose, though I think it advisable that a license of some sort should be insisted on as a guarantee of *bonâ fides* and a security against abuse of the concession.

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*Reference—No.* 783, *dated* 5*th April* 1909.

The Chief Engineer for Irrigation is requested to favour the Board with his opinion on the letter from the Collector of Tanjore.

L. D. SWAMIKANNU,
*Secretary.*

To the Chief Engineer for Irrigation with enclosure in original to be returned.

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ENCLOSURES.

*Note by Executive Engineer, Cauvery Division, on the second deputation.*
*(Nidamangalam).*

* * * * *

*Subject No. IV—Village Pastures.*—I should have no objection to grazing on Public Works padugais *per se*, if the conservancy plantations along the margins could be effectively protected without prohibitive cost.

The Cauvery Delta being such as it is, the river margins *must* be trained and protected and the ryots would be the first to complain if this were not done. In many localities, the ryots deliberately drive their cattle into these plantations, the rich pasturage obtained being well worth the risk of an occasional pound fee.

The leasing out of these padugais for cultivation is only a means to a very desirable end, viz., the growth of fuel timber, fuel being as scarce as pasturage in most parts of the delta.

If the scarcity of grazing be admitted to be a serious matter, I am prepared to consider proposals for the reservation of strongly enclosed grazing grounds at intervals down the river margins, with a *quid pro quo* in the shape of *really* prohibitive pound fees for the adjacent localities.

* * * * *

A. H. MORIN,
*Executive Engineer, Cauvery Division.*

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*Note by the Collector.*

The insufficiency of pasture lands has been a standing complaint in the Tanjore district. So long ago as 1801, Mr. Harris, the Collector, wrote to the Board of Revenue: "It is on account of this deficiency, that the inhabitants never kept more cattle than they required and almost always have less." In the deltaic portion of the district, wet cultivation is in such demand that practically every valuable piece of land is brought under the plough; and, wherever possible, dry cultivation is replaced by wet. The area of reserved forest in the district is quite inconsiderable, covering, as it does, only about 19 square miles. Grazing is, however,

allowed in the reserved areas at nominal rates, except as regards a few specially protected plots. What common pasture there is, consists of unassigned assessed waste lands, bunds of rivers and irrigation channels, public topes and other varieties of poramboke, upon which grass happens to grow. These areas continually suffer from encroachments Cattle-stand porambokes are often devoid of grass and consist merely of small bits of land set apart with a view to furnishing standing ground for the village cattle, when they are not actually housed. As for poramboke padugais (river margins) in charge of the Public Works Department, these are not very extensive and there are very good reasons against their being thrown open to indiscriminate pasturage (*vide* Mr. Morin's note on the point).

2. In 1906, the Board called for a report on a letter from the Superintendent, Civil Veterinary Department, regarding measures to be taken to preserve and extend pasture grounds. Besides the Divisional Officers and the District Forest Officer, opinions were invited from the Tanjore District Central Agricultural and Industrial Committee; and both the Executive Engineers of the district were consulted on the particular question of throwing padugais open for free-grazing. The Executive Engineer, Tanjore, wrote "With the exception of a few areas "in the Coleroon and the slopes of some of the banks, the Public Works padugais do not "comprise any pasturable land, and what cattle do graze on, when they have the chance, is our "protective plantations of *nanal* and other growths. Excluding these protective growths, the "padugais comprise arable land and fuel plantations. The former is at present in the majority, "but I hope in a few years' time to convert all padugais into fuel producers. Cattle cannot be "allowed on the banks, because of the very considerable wear and tear they cause, and they "obviously cannot be allowed to defeat our efforts in river conservancy by grazing on the "protective plantations. They might, however, be admitted to the padugais, provided that the "banks and the protective plantations were suitably fenced. Whether or not Government is "prepared to bear the very considerable cost of such fencing is another question."

The Executive Engineer, Negapatam, replied in the same strain. He said that the practice had been to prevent cattle from trespassing on padugais, in order to preserve the *nanal* and other protective plantations on the margin of rivers on which the Public Works Department had been spending large amount of money annually, that there could be no harm in allowing cattle grazing in places where the padugais were extensive and where there were no protective plantations, but that the number of such extensive padugais in his division was very limited. The total area of padugai poramboke in charge of the Public Works Department is extremely small It does not exceed 1,329 acres or 2·06 square miles. Permitting free-grazing on this area would thus confer a very limited advantage on the public, whilst it would raise the very difficult question of protecting from damage the valuable protective plantations on the margins of rivers.

The leasing out of these padugais for cultivation, to which the deputation takes objection, is intended as a means to a very desirable end, viz., the protection of *nanal* and other river conservancy plantations and the creation of fuel reserves to serve as buffers to these plantations. Fuel, it may be added, is as scarce in most parts of the district as pasturage. The only possible method of admitting cattle to padugais for pasture would be to strongly enclose portions of them down the river margins at intervals as grazing grounds and levy a fairly heavy fee for the admission of cattle and a prohibitive fee for trespass on the adjacent unenclosed padugais. The conservancy would be a difficult and expensive affair.

3. The District Central Agricultural and Industrial Committee, which was consulted on the general question of pasturage, recommend that Revenue Officers should make a special consideration of the local grazing requirements, an invariable preliminary to assignment of land or its transfer to poramboke and that they should also consider the advisability of special grazing reservations, whilst the District Forest Officer should, wherever practicable, permit grazing in padugais. The recommendation made in respect with padugais has been dealt with in the preceding paragraphs. The other recommendations of the Committee have been given effect to. The trouble is that there is so little communal land to protect.

4. In reply to the Board's reference on the letter from the Superintendent, Civil Veterinary Department, already alluded to, Mr. Davidson suggested the following remedial measures :—

(1) increased stringency in dealing with applications for the transfer of village poramboke to assessed land ;

(2) the issue of orders requiring that assessed waste land shall never be assigned on patta, unless and until the grazing requirements of the village have been duly considered ;

(3) the definite classification, as grazing ground, of conveniently situated and reasonably large blocks of waste land, particularly in the immediate vicinity of village sites ; and

(4) the encouragement of the cultivation of improved fodder grass.

5. These measures were communicated to the Divisional Officers, with instructions to consider the communal needs of villages in their respective divisions in the course of jamabandi and also when dealing with darkhasts. A question has been added in the jamabandi check memorandum as to whether the grazing requirements of each village are sufficient. A circular has also been

issued, directing village officers to invariably make a note when submitting darkhast applications, as to the existing facilities for grazing and as to whether the wastes applied for on darkhast are required as grazing ground. In respect of assignment of poramboke lands, village officers have similarly been ordered to append a certificate to transfer applications that the lands are not required for any communal purpose; the supervising revenue officers, viz., Revenue Inspectors, Deputy Tahsildars and Tahsildars, have been required to carefully verify the village officers' certificates. Transfers are also being made of conveniently situated blocks of waste lands to grazing ground poramboke, whenever such a course is expedient and practicable.

6. The cultivation of fodder crops as well as pasture on wet lands, both before the raising of the principal wet crop and after its harvest, has been exempted from water-cess, in the orders of Government embodied in Board's Proceedings Nos. 423-R.S., dated 24th October 1904, and 446-R.S., dated 28th November 1906, and these orders have been published in diglott in the District Gazette. Although these concessions are specially meant for the benefit of the agricultural population of deltaic districts like Tanjore, the people of this district have not availed themselves of them. If the ryots would take advantage of these liberal concessions and begin to grow fodder crops on their wet lands, it would help to overcome the difficulties arising from want of sufficient pasture grounds.

In the non-deltaic portions of the district, there is no lack of pasturage. In the Pattukkóttai taluk, especially, large tracts of waste land are still available and are unlikely to be brought under the plough in the near future, unless and until a marked expansion of cultivation takes place in consequence of the execution of the new irrigation projects or causes at present unforeseen.

*7th February* 1908.

J. P. Bedford,
*Collector.*

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*Letter*—from A. H. Morin, Esq., Executive Engineer, Cauvery Division.
*To*—the Collector of Tanjore.
*Dated*—the 16th March 1908.
*No.*—1655.

In my notes regarding certain questions raised by the two deputations on the occasion of His Excellency the Governor's recent visit, I made a proposal to reserve selected plots of padugai land in the delta as village grazing grounds.

2. I should be obliged for an early expression of opinion from you on this point as I want to decide what to do with the Public Works Department padugais when the current leases expire (in June next).

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*Endorsement*—from A. H. Morin, Esq., Executive Engineer, Cauvery Division.
*To*—the Divisional Officer, Tanjore.
*Dated*—the 16th March 1908.
*No.*—1676.

Returned.

I am very hazy as to the rights of the people in this matter. What they ask for here is *free grazing on Public Works Department poramboke* and you say that there appears to be no precedent for such a concession.

On the other hand, at the deputation before the Governor the other day, I was informed that "poramboke" means "*grazing ground*" and nothing else which would imply that I have no right to exclude cattle from Public Works Department padugais.

In any case, I have already made a suggestion to the Collector on this subject and am awaiting a reply.

Until some general policy is decided on, the particular request under reference cannot be complied with. It is, however, not my business to take the initiative, as I naturally do not want free grazing or any grazing on Public Works Department padugais, if I can help it.

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*Letter*—from M.R.Ry. T. Seshiah Avargal, Deputy Collector, Tanjore Division.
*To*—the Collector of Tanjore.
*Dated*—the 29th March 1908.
*No.*—D. Dis. 672/Rev.

I have the honour to submit the correspondence ending with No. 1676, dated 16th March 1908, from the Executive Engineer, Cauvery Division, regarding the reservation of certain padugai land for grazing ground purposes and to report as follows.

Petitioners, some of the ryots, etc., of Koviladi village, Tanjore, request that the Public Works Department padugai in S. No. 481/D may be reserved for grazing purpose. On a reference to the Public Works Department, it has been ascertained that the land under reference is usually leased out by that department and there seems to have been no precedent for the grant of the concession of the kind in question. The Executive Engineer states that he has already made some suggestion to you on the subject and is awaiting your reply, and informs me that until some general policy is decided, the petitioners' request in the case cannot be complied with. I submit the case for favour of your orders.

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*Letter*—from A. F. G. MOSCARDI, Esq., I.C.S., Sub-Collector, Kumbakónam.
*To*—the Collector of Tanjore.
*Dated*—the 23rd May 1908.
*No.*—D. Dis. 915.

In reply to your R.C. No. 1483/G.R., dated 29th April 1908, I have the honour to state that having regard to the limited extent of grazing lands in the deltaic tracts, it is necessary that padugais at the disposal of Government should be thrown open for grazing purposes free of cost, the bund and the river margin on either side being, if necessary, protected with aloe or other permanent fencing plants. The initial cost may perhaps be heavy, but it seems worth incurring in the interests of the live-stock which is very inferior in these parts for want of pasturage in the cultivation season. The permanent fence that may be grown may be taken care of by the Public Works Department agency which looks after the present *nanal* plantation along the river margin.

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*Letter*—from W. H. H. CHATTERTON, Esq., B.A., Deputy Collector, Pattukkóttai Division.
*To*—the Collector of Tanjore.
*Dated*—the 29th June 1908.
*No.*—D. Dis. 889-Rev.

With reference to your R.C. No. 1483/G.R., dated 29th April 1908, requesting to offer remarks regarding the reservation of river padugais for pasture lands in the deltaic parts, I have the honour to state that such reservation will be welcomed by the general public and will remove, to a certain extent, the standing complaint of insufficiency of pasture lands. This can be done only in places where there are large extents of padugais, leaving a fair margin of not less than 25 yards for the protection of the river.

2. A watch would be necessary to guard this and to prohibit the cattle from entering unenclosed padugais. Such trespassing cattle should be taken to the nearest pound. A fee of As. 3 per month may be levied per head of cattle left to graze in such enclosed padugais. The selection of sites, etc., for such purposes should be left to the Public Works Department authorities, as it will require professional skill.

3. Nanal plantation is the main source of protection to the padugais. If all cattle graze in such padugais, it is only this nanal plantation and such lands should be prohibited from being allowed for cattle-grazing.

4. The advantage derived by leasing out the padugais for cultivation would be less than by reserving them for grazing ground. The want of pasture land is more felt by people than fuel or timber for household purposes, which they can obtain at a slight cost. The planting of fuel trees may also be done as an enclosure to the pasture grounds in the course of some years.

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*Letter*—from M.R.Ry. P. DORAISWAMI AIYANGAR Avargal, B.A., Deputy Collector, Máyavaram.
*To*—the Collector of Tanjore.
*Dated*—the 8th July 1908.
*No.*—D. Dis. 1164-R.

With advertence to your reference on R.C. No. 1483/G.R., dated 29th April 1908, I have the honour to submit herewith the reports of the Tahsildars of Máyavaram and Shiyali, and to report that the insufficiency of pasture grounds is necessarily a matter of complaint in the deltaic parts of the district more than the upland parts, the apparent reason being that in the former there is a natural tendency to cultivate all available lands with paddy crop, preferably on account of systematic supply of water, such an advantage being wanting in the latter where everything depends upon rains. The delta having thus been tapped by a number of rivers, I think it may be possible to reserve a number of padugai lands for pasture grounds so as to benefit a large number of villages. In addition to this precaution, all available waste lands

outside padugais may be reserved as grazing grounds and this is now being done wherever possible, special attention being paid to it both at the time of jamabandi and at the time of assignment, as to the advisability of reserving them as such, in pursuance of the recent orders on the subject There is not much of forest reserves in my division except in two or three villages and these may also be made open to public use without detriment to forest conservancy.

2. In any case, the tax, if any that may be levied for the free use of padugais and forest reserves as grazing grounds should be only nominal. They should not be so high as to keep the ryots away from them. I am in favour of allowing also such use free of any tax wherever possible.

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*Letter*—from W. H. H. Chatterton, Esq., B.A., Deputy Collector in charge, Negapatam.
*To*—the Collector of Tanjore.
*Dated*—the 21st July 1908.
*No.*—D. Dis. 2401-Rev.

Referring to your R.C. No. 1483/G.R., dated the 29th April 1908, on the proposal to reserve the padugai lands in the delta for grazing purposes, both the Tahsildars and the leading ryots in the division have been consulted and there is a concurrence of opinion that the available padugais in the division are by themselves not very extensive and so insufficient and that it would be a great hardship to impose any prohibitive pound-fee in respect of cattle-grazing on them, inasmuch as the ryots have been under the *bona fide* belief that it is within their customary rights to graze their cattle on such padugais.

Some are of opinion that the imposition of any such restrictions would only pave the way for a levy of blackmail by the Public Works Department subordinates from the ryots, while, as a matter of fact, matters would in no way be improved. In the case of prohibitive works and plantations, necessary fences may be raised to prevent ingress and this would seem to suffice. The Tahsildar of Nannilam suggests that it would be a great improvement to transfer to the head of "grazing ground" all the available waste, as is now being done, and to encourage the ryots in the direction of growing of grass thereon, even with the aid of Government water, without any water-charge, and I agree with him.

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*Letter*—from M.R.Ry. V. Narasimha Aiyangar Avargal, Deputy Collector, Mannárgudi.
*To*—the Collector of Tanjore.
*Dated*—the 29th July 1908.
*No.*—D. Dis. 1454/Rev. of 1908.

Adverting to your R.C. No. 1483/G.R. of 1908, dated 29th April 1908, I have the honour to report that in the deltaic tracts where there are padugais, the area available for grazing is small and that the extent of padugais available for pasturage is also small.

2. As regards the safety of the banks of the rivers and channels insisted on by the Public Works Department, the protective plantation raised on the padugais may be fenced round and the remaining extent of the padugais thrown open not to *indiscriminate* pasturage, but to the cattle required for performing the necessary agricultural operations in the villages concerned. Owing to the comparatively small extent of land available as pasturage, there will be a scramble for it and unrestricted grazing will result in the pasture disappearing in a very short time. A fee may be fixed for each head of necessary cattle and with the amount realised as such, such grazing grounds may be fenced round and reserved as village pasture, any deficiency being made good by the villagers themselves, or half of it by the villagers and the other half by the Government.

3. The Tahsildars' reports are enclosed.

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*Letter*—from M.R.Ry. T. Seshiah Avargal, B.A., Deputy Collector, Tanjore.
*To*—the Collector of Tanjore.
*Dated*—the 27th October 1908
*No.*—D. Dis. 2569/Rev. of 1908.

With reference to your R.C. No. 1383/G.R. of 1908, dated 29th April 1908, regarding the question of cattle-grazing on the padugai lands of rivers in charge of the Public Works Department, I have the honour to report that the want of sufficient pasture, especially in the deltaic parts of the division, is keenly felt by the agricultural classes of people and that any concession that may be granted in the matter of allowing cattle grazing on padugai lands in charge of the Public Works Department would be a boon to the public and will help the improvement of agricultural stock.

2. A list of Public Works Department padugai lands in the several villages of the taluk, with particulars as to the other grazing grounds available in them, is enclosed. The information has not been tabulated on a uniform principle and I doubt if the information is complete. To save delay, I submit the statements as they are. The Government may well forego, in the interests of agricultural stock, any income which they derive by the lease of the padugais. The lessees practically cultivate the padugai lands, and I doubt whether the cultivation conduces to the conservancy of the river padugais.

3. I would submit that the padugai lands may be thrown open for cattle grazing with such conditions and restrictions as may be found desirable in the interests of the conservancy of the rivers concerned. As regards the latter point, the Executive Engineer suggests that the conditions should be prescribed by the Revenue Department. The matter is one more or less for the Public Works Department to settle. The only conditions which suggest themselves to me are (1) to throw open the padugais for grazing in alternate years, and (2) reserve a small margin close to the river which may be fenced where necessary.

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*Letter*—from J. P. BEDFORD, Esq., I.C.S., Collector of Tanjore.
*To*—the Executive Engineer, Cauvery Division.
*Dated*—the 16th December 1908.
*No.*—R.C. 1483/G.R. of 1908.

With reference to your letter No. 1655, dated 16th March 1908, and in continuation of this office R.C. No. 1483/G.R. of 1908, dated 29th April 1908, I have the honour to forward copies of my Divisional Officers' letters on the question of allowing cattle-grazing on padugai lands, and to state that I agree with their views which are substantially the same as yours.

2. I would however deprecate the charge of fees for the use of padugai lands as grazing ground, though I agree with the Divisional Officer, Mannárgudi, in thinking that discrimination is advisable and that a license of some sort should be insisted on. I would request you to be good enough to formulate suggestions and rules on these lines as early as possible in consultation with the Vennar Executive Engineer, to whom I am sending copies of the whole correspondence.

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*Letter*—from A. H. MORIN, Esq., Executive Engineer, Cauvery Division.
*To*—the Collector of Tanjore.
*Dated*—the 14th February 1909.
*No.*—1220.

With reference to your R. C. No. 1483/G.R. of 1908, dated 16th December 1908, I have the honour to state that I have since discussed the matter with the Superintending Engineer and we came to the conclusion that the small extent of padugai land available (some 120 acres only) hardly warrants such a proposal as that originally made by me. The fact that the bulk of the padugais are concentrated towards the west of the district also rather vitiates the proposal, since it is the eastern portion of the delta that is more particularly deficient in pasturage.

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## III

### Note by the Chief Engineer for Irrigation.

Submitted to Government.

2. The Board of Revenue requests the remarks of the Chief Engineer for Irrigation on a proposal of the Collector of Tanjore to throw open all padugai lands in the district for free grazing.

3. All padugais which are not required for purposes of river conservancy are being handed over to the Forest department with reference to rule 1 of the rules approved in G.O., No. 222 I., dated 14th May 1907. Padugais which are not fit to be so handed over are generally not fit for grazing, and as a general rule grazing will not be permitted on them. Grazing may, however, be permitted on portions of padugais in charge of the Public Works Department if the Superintending Engineer is prepared to allow it, but it is gathered from the correspondence forwarded that such portions are very limited. It is also clear that portions of padugais in charge of the Public Works Department thrown open for grazing will require to be strongly fenced off for the protection of nanal plantations, and therefore those who use them for grazing purposes should pay such sum as will cover the cost of these works.

The amount in each case may be fixed by the Superintending Engineer on the estimate of cost, and any persons desirous of grazing their cattle should deposit that amount before any expenditure is incurred.

15*th June* 1909.

C. A. SMITH,
*Chief Engineer for Irrigation.*

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**Order—No. 270 I., dated 23rd June 1909.**

The Government agree with the opinions and recommendation of the Chief Engineer for Irrigation as expressed in the above note.

(True Extract.)

C. A. SMITH,
*Joint Secy. to Govt., P.W.D.,*
*Irrigation Branch.*

To the Chief Engineer for Irrigation.
,, Superintending Engineer, V Circle.
,, Board of Revenue (Revenue Settlement).

Copy to the Superintending Engineer, VI Circle, for information.
,, the Revenue Department.

# Government of Madras.

PUBLIC WORKS DEPARTMENT.

IRRIGATION.

*Recd.* } 1909. *Enclosures*

*Regd.* *Spare copies*

## G.O., No. 271 I., 23rd June 1909.

**Seigniorage on earth taken for repair of tank and channel banks.**

Stating with remarks that — will not be levied from an individual who is certified as a piece-worker by a responsible officer of the Public Works Department.

GOVERNMENT OF MADRAS.

PUBLIC WORKS DEPARTMENT.

## Irrigation.

Read—the following papers :—

I

### G.O., No. 140 I., dated 26th March 1907.

Abstract.—Exempting piece-workers working in the Public Works Department from the payment of seigniorage on sand taken from river beds.

### G.O., No. 499 I., dated 19th November 1907.

Aastract.—Exempting, with remarks, piece-workers working directly under the officers of the Public Works Department from the payment of seigniorage on kankar collected from unreserved land.

II

*Letter*—from S. D. Pears, Esq., Superintending Engineer, V Circle.
*To*—the Chief Engineer for Irrigation.
*Dated*—Chepauk, the 20th May 1909.
*No.*—191 E.I.

I have the honour to report that the Revenue Department are charging seigniorage in the Cauvery Division for earth excavated for the ordinary repair of channel banks.

2. A copy of the Collector's D. Dis. No. 1914, Rev. of 1909, dated 27th April 1909, is enclosed.

3. It is reported to me that work has in many cases been actually brought to a standstill by this demand. This of course cannot be allowed to happen and I have accordingly instructed the Executive Engineer to inform contractors or piece-workers that they must pay the seigniorage without demur and that their agreement rates will all be raised by the amount of seigniorage charged.

4. I doubt, however, if the Collector is correct in placing this interpretation on the "existing rules", by which I presume that he means the Board's Standing Order No. 25 B (iv) Note 2. For, in the first place, it is at least questionable whether earth is a building material when it is not used for building but for banking, and in the second place practically all the earthwork in the Tanjore district is done on piece-work agreements and under the direct supervision of the Public Works Department establishment, the condition implied in the Board's Standing Order above quoted being thus fulfilled.

5. I beg, however, that the matter may be made clear by an order of Government exempting earth, at any rate for banking tanks or channels, as sand (equally a building material) has already been exempted in G.O., No. 140 I., dated 26th March 1907.

6. I would take the opportunity to urge the abolition of the distinction between contract and piece-work to which the Collector refers and which is implied in the Board's Standing Order above quoted. A piece work agreement is just as much a contract as the sometimes more convenient "Schedule" Contract (Public Works Department Form K-1) and neither is either more or less "under the direct supervision" of the Public Works Department than the other. A great deal of needless trouble has, in my own experience, arisen under the seigniorage rules from the fact that the officers and subordinates both of the Public Works Department and of other departments habitually and correctly speak of a man working under a piece-work agreement as the "contractor". I have in fact known a whole working season lost on a work while it was being argued first whether seigniorage was to be charged or not, and second whether the contractor or the Public Works Department was to bear the seigniorage, before the Collector concerned ultimately assimilated the fact that the contractor was working on a piece-work agreement and decided that no seigniorage was chargeable. To incur practical evils of this sort is, I submit, to pay too dearly for the object it is sought to secure. That object, I presume, is to prevent a contractor from removing materials for his own private purposes, and though it would no doubt occasionally happen that a contractor if he paid no seigniorage might, to a slightly greater extent than he does now, make away with small quantities of gravel, stone, etc. (just as he does occasionally and with the connivance of subordinates filch small quantities of bricks or lime supplied to him by the Public Works Department) I maintain that the direct supervision of the Public Works Department over him, whether he be working under Public Works Department form K-1 or Public Works Department form K-2, is such that any small abstractions of the kind would be far more than paid for by the convenience which would result from the withdrawal of restrictions which not only irritate but on occasions such as the present, seriously interfere with important work.

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ENCLOSURE.

*Letter*—from J. P. BEDFORD, Esq., I.C.S., Collector of Tanjore.
*To*—the Executive Engineer, Cauvery Division.
*Dated*—the 27th April 1909.
*No.*—D. Dis. 1914-Rev.

With reference to your letter No. 1647, dated 3rd March 1909, I have the honour to invite your attention to G.O., No. 140 I., dated 26th March 1907, wherein a distinction has been made between piece-workers and contractors employed by the Public Works Department. In these circumstances, my D. Dis. No. 5305 of 1908, dated 23rd December 1908, does not seem to require any modification. Earth is a "building material" and is liable to be charged with seigniorage under the existing rules. If you are dissatisfied with the existing rules or their application, it is open to you to address your departmental superiors in the matter. Meanwhile I must request that the rules, as interpreted by me, be adhered to.

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**Order—No. 271 I., dated 23rd June 1909.**

The case brought to notice by the Superintending Engineer, V Circle, in his letter read above is governed by the orders in G.O., No 140 I., dated 26th March 1907. A separate order exempting "earth" from seigniorage in the same way as sand, is not therefore necessary.

2. A certificate from a responsible officer of the Public Works Department not below the rank of Sub-Divisional officer to the effect that a particular individual is a piece-worker taking earth for Public Works Department purposes will be sufficient authority for him to claim exemption from seigniorage.

3. The suggestion in paragraph 6 of the Superintending Engineer's letter that no distinction should be made between piece-workers and contractors cannot be accepted.

(True Extract.)

C. A. SMITH,
*Joint Secy. to Govt., P.W.D.,*
*Irrigation Branch.*

To the Superintending Engineer, V Circle.
,, the Chief Engineer for Irrigation.
,, the other Superintending Engineers.
,, the Revenue Department,

# Government of Madras.

## PUBLIC WORKS DEPARTMENT.

IRRIGATION.

*Recd.* } 1909. *Enclosures*

*Regd.* *Spare copies*

## G.O., No. 272 I., 24th June 1909.

### Shiyali taluk water-supply, Tanjore district.

Approving, with remarks, the proposals of the Chief Engineer for Irrigation that improvements to the — should await the question of the construction of the Cauvery reservoir.

GOVERNMENT OF MADRAS.

PUBLIC WORKS DEPARTMENT.

**Irrigation.**

**Read**—the following papers :—

I

**G.O., No. 1780 W., dated 24th August 1906.**

Abstract.—Ordering, with remarks, that Mr. V. T. Srinivasa Aiyangar, Sub-Engineer, be posted for duty under Mr. Morin for the collection of the requisite data in connection with the regulation of the water-supply to the Shiyali taluk, Tanjore district.

II

*Letter*—from H. E. Clerk, Esq., Superintending Engineer, V Circle.
*To*—the Chief Engineer for Irrigation.
*Dated*—Madras, the 5th April 1907.
*No.*—127-E.I.

With reference to paragraph 4 of G.O., No. 1780 W., dated 24th August 1906, I have the honour to forward a copy of correspondence with the Collector of Tanjore, and to state that in my opinion a much more radical change than anything suggested in the above-quoted Proceedings is required. My views on the subject are set forth in a note now being typed and I consider that if any enquiry at all is made it should be on the lines laid down therein. If, however, it is still wished that some modification of the existing morais should be undertaken, I would suggest that the enquiry should be deferred for a year until the newly-constituted divisions have worked during an irrigation season. It is possible (though not likely) that some of the difficulties experienced may disappear when the Vennar division has control of the Vennar from the head downwards.

Enclosures.

(i)

*Letter*—from the Superintending Engineer, V Circle.
*To*—the Collector of Tanjore.
*Dated*—the 14th September 1906.
*No.*—577-M.

I enclose a copy of G.O., No. 1780 W., dated 24th August 1906, and invite attention to paragraph 4 directing me to consult you on the matter. The idea attributed to me in the order is not mine and I made no such proposal, but I pointed out that the "morai" for time of low supply of the Cauvery-Vennar regulators did not seem a satisfactory one and recommended that a special enquiry into this matter might now be instituted. The matter is a complicated one as any change in the Cauvery-Vennar distribution must affect the distribution rules and morais all through the delta. Some of these have been in existence long before the Cauvery-Vennar regulators were built, and the whole question is a very complicated one and would have to be carefully worked out for the whole system. The fact that it is a complicated matter and that apparently no one quite understands the reasons for the present "morai" in my mind makes investigation very desirable, and one was consequently proposed to be held when the connected matter of the Lower Coleroon Anicut distribution was under enquiry.

I would ask for an expression of your opinion on the above subject and if you concur in the desirability of this matter being made the subject of special enquiry.

(ii)

*Letter*—from the Acting Collector of Tanjore.
*To*—the Superintending Engineer, V Circle.
*Dated*—the 26th January 1907.
*No.*—D. Dis. 365.

In reply to your letter No. 577-M., dated the 14th September 1906, I have the honour to inform you that I consider that a detailed enquiry by a special officer is absolutely necessary, before bringing into effect any scheme for closing the sluices in the upper reaches of the Cauvery and its branches, in order to force water down to the lower reaches. Personally, I am generally in favour of the proposal on the merits, but I am not prepared to say that it will not involve legal difficulties and undoubtedly the effect of the proposal on the minor morais would need careful consideration. My enquiries made so far mainly show that the ryots low down in the delta would welcome the proposal or some similar proposal, whilst the ryots higher up object to it. These expressions of opinion are what might have been expected. Without the opinion of a technical expert on the detailed effect of the proposals and a consideration of the legal aspect of the question, it would be most dangerous to make any innovation.

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III

*Letter*—from S. D. PEARS, Esq., Superintending Engineer, V Circle.
*To*—the Chief Engineer for Irrigation.
*Dated*—Chepauk, the 1st May 1907.
*No.*—157-E.I.

With reference to G.O., No. 1780 W., dated 24th August 1906, I have the honour to enclose in original the Cauvery Division Executive Engineer's No. 3291, dated 18th April 1907, giving cover to Sub-Engineer Mr. V. T. Srinivasa Aiyangar's preliminary report and its accompaniments on Shiyali taluk and the Cauvery-Vennar morais.

2. Starting from first principles, the proper place from which to introduce water for the irrigation of a delta is the head of the delta. The Lower Anicut may be correctly placed for the irrigation of Chidambaram taluk, but to irrigate any part of the Tanjore delta from it is to introduce nourishment through the ribs of a patient whose alimentary canal merely needs treatment.

3. As between the Coleroon and the Cauvery therefore, the Cauvery is *primâ facie* the proper source from which to supply the Palavar irrigation in Shiyali taluk. If further reasons be needed we have first the existing intimate connection between Shiyali taluk and the Cauvery delta; we have, next, the Vikramanar ready to hand for the purpose (Mr. Morin's paragraph 17), and to these may be added, thirdly, that the drainage of Shiyali taluk will be easier if it consists only of the surplusage of Kumbakónam and Máyavaram than if of the surplusage of these taluks *plus* an independent discharge let in at the Lower Anicut.

4. It is possibly true that the remodelling of the whole Cauvery delta which you are advocating will take longer than would the remodelling of the Lower Anicut system only, and that a supplementary supply could therefore be probably brought in from the Lower Anicut a few years sooner than from the Cauvery, but it would be short-sighted to do the wrong thing now rather than wait a some what longer for the right thing.

5. Moreover the Sub-Engineer's enclosure N (statement showing the supply available in the Coleroon) suggests an additional argument. The Sub-Engineer contends, and Mr. Morin appears to accept his contention, that the reorganisation of the Lower Anicut system will save enough water to form the requisite additional supply to the Palavar. It seems to me quite open to question.

6. The readings are evidently not to be too much relied on, for there are many obvious errors. But taking enclosure N (statement showing the supply available in the Coleroon) for what it is worth, it will be seen that *at present* there is constantly no water whatever available at the Lower Anicut during December and January (the very months when it is chiefly wanted under the Palavar) and not infrequently in other months as well. (June to October 1902, August to October 1904, etc.) It is probably not too much to assume that there is at such times a deficient supply to the existing irrigation. The remodelling of the Cauvery delta to take only 14,793 cubic

feet per second would no doubt furnish all the savings required, but it is not easy to be sure that the remodelling of the Lower Anicut system alone would furnish enough (*a*) to serve the Palavar, (*b*) to serve these existing deficiencies, and (*c*) to provide the extra supply that will be demanded by the Vadavar on completion of the improvements recently begun. If after the Coleroon-Palavar channel were complete it should be found that the remodelling of the Cauvery delta had still to be awaited, even the slight argument of the supposed saving in time (my paragraph 4, above) would be worthless.

7. Apart, however, from the purposes of the Palavar there is apparently a good deal of good work to be done in remodelling the Lower Anicut system.

8. First as to the Vadavar. The Sub-Engineer's proposal for a separate channel for direct irrigation has been decisively pronounced against by Mr. Davidson in his report printed at page 20 of G.O., No. 944 I., dated 1st September 1906. The Sub-Engineer's other criticisms of the work now in progress on the Vadavar are also probably such as will not commend themselves to you.

9. But as to the North and South Rajan voikals, the Khan Sahib's canal and the Pasumuthan odai, there seems no reason why their detailed investigation should not be gone on with. As to their urgency, the suitability of the Sub-Engineer's proposals, and the possibility of carrying them out till the Irrigation Act is passed, I have not the requisite local knowledge for forming an opinion, but your own knowledge of their conditions is such that you will probably need no assistance in deciding. If not, I will, if so ordered, go further into the matter and report again after personal inspection.

10. With regard to the Cauvery and Vennar morais, it seems evident that revision must await the Irrigation Act. If revised now, they would probably have to be only revised again when the Act is passed besides giving rise to trouble meanwhile.

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ENCLOSURES.

*Letter*—from A. H. MORIN, Esq., Executive Engineer, Cauvery Division.
*To*—the Superintending Engineer, V Circle.
*Dated*—the 18th April 1907.
*No.*—3291.

With reference to your No. 27-T.J., dated 10th January 1907, I have the honour to submit herewith Mr. Srinivasa Aiyangar's preliminary report on his investigation of the defective supply in Shiyali taluk, after correcting and editing it to a certain extent. A few passages are a little obscure, but unfortunately I have not been able to discuss them with him owing to his transfer.

2. After giving a historical description of the Cauvery delta system in general and the Lower Anicut system in particular, and discussing the several investigations into the latter, he arrives at the following general conclusions :—

(1) that the whole Cauvery delta wants remodelling with a view to increasing its efficiency ;

(2) that the Lower Anicut System in particular wants remodelling with the same object ;

(3) that the latter need not wait for the former, which cannot be done without an Irrigation Act ;

(4) that the remodelling of the Lower Anicut system proper on the lines proposed will not only secure a sufficient supply for its own needs but will set free enough water wherewith to supplement the Palavar system ;

(5) that the remodelling of the whole delta will still further improve these conditions.

3. These conclusions are fairly obvious and had already been admitted, the only doubtful point being whether there would, under any circumstances, be water to spare for the Palavar. This doubt Mr. Srinivasa Aiyangar has now settled with tolerable certainty.

4. He also arrives at the following particular conclusions :—

(6) that during a certain portion of the year the Palavar lands in Shiyali can, with the help of the north-east monsoon, be independent of any supply from the delta ;

(7) that about 2,000 cusecs can be made available at Lower Anicut for use elsewhere than in the Lower Anicut system ;

(8) that the Cauvery can afford to spare enough during July, August and September to enable the Palavar to make an early start with its cultivation;

(9) that the advantages of supplementing the Palavar from the Coleroon or the Cauvery are about equal; and

(10) that the Vadavar has the prior claim to consideration.

5. The means by which he proposes to attain his object may be summarized as follows:—

(a) the internal improvement of—

(1) the South Rajan voikal,
(2) the North Rajan voikal,
(3) the Vadavar,
(4) the Khan Sahib's canal,

with a view to increasing their duty and thereby setting free some of the water available at the Lower Anicut for the benefit of the Palavar;

(b) similar improvement of the Palavar itself with a view to reducing the supplemental supply required to a minimum;

(c) direct supplementing of the Palavar from the Lower Anicut by means of an independent channel therefrom; and also

(d) indirect supplementing of the Palavar by means of a channel connecting the Cauvery with the Manniar near Vaduvagudi surplus.

6. The improvements proposed under (a) are as follows.—

(1) *South Rajan voikal*—

(i) Straightening, sectioning and regrading the channel throughout;
(ii) sluicing distributaries;
(iii) abolishing the morai at Sidhamalli calingula and giving the Sidhamalli channel an offtake higher up;
(iv) abolishing the morai at Vadarangam channel and building a new regulator with offtakes higher up;
(v) building a regulator near the tail end of the channel where it splits into four;
(vi) increasing the waterway at the two big aqueducts; and
(vii) raising and widening the banks throughout to facilitate inspection.

(2) *North Rajan voikal*—

(i) Straightening, sectioning and regrading the channel throughout;
(ii) sluicing distributaries;
(iii) taking heads of distributaries for high lands higher up;
(iv) abolishing morai at Omambuliyur calingula either by taking heads of distributaries higher up or by giving the lands a new and independent head from Lower Anicut;
(v) abolishing morais similarly at Puliyangudi, Gopadi and Vuyyur calingulas by taking heads of distributaries higher up; and
(vi) realigning minor distributaries.

(3) *Vadavar*—

(i) Providing a separate channel from the Lower Anicut for lands now irrigated direct (*vide* item (iv) under North Rajan voikal) thus making the Vadavar solely a tank feeder;
(ii) demolishing the two regulators across the Pasumuthan odai, providing the road bridge above Thilliamman surplus with shutters and providing a side channel for the lands now under these two regulators;
(iii) removing the left bank of the same odai and widening the odai so as to include the Muthangudi drain; and
(iv) digging a straight cut from Pasumuthan odai to the Vellar.

He also criticises the project just sanctioned for the improvement of the Vadavar and Viranam tank and suggests the construction of head sluices for the Vadavar and the North Rajan voikal at right angles to the Lower Anicut, the deepening of the last eight bays of the anicut by 5 feet and the construction of a training wall from the eighth vent with a similar arrangement on the extreme right flank to balance it.

(4) *Khan Sahib's canal*—

(i) Giving the canal a direct supply either from the Viranam tank by means of a vent in one of its weirs, or from the North Rajan voikal if item (1) under the Vadavar is carried out; in the latter case a regulator being constructed across the North Rajan voikal, a mile above Puliyangudi calingula;
(ii) widening the canal from the regulator below Komaratchi to Tiruvakulam surplus;
(iii) constructing a regulator across the canal to keep out flood water below the Tiruvakulam surplus;
(iv) increasing the waterway of the Muthaya Pillai and Tiruvakulam surpluses;
(v) widening and straightening the Uppanar and widening the Old Coleroon; and
(vi) making a straight cut from the Uppanar to the Backwater.

7. The improvements proposed under (*b*), the Palavar itself, are as follows :—

(i) Straightening the river and raising the right bank from the infall of the Manniar downwards ;
(ii) demolishing Gopalasamudram dam and taking the high-level offtakes higher up ;
(iii) demolishing the present arrangement at Mukkutu regulator and providing the centre bay of the bridge with a shutter ;
(iv) regrading the Govinda Cauvery ;
(v) resluicing the distributaries below Gopalasamudram dam ;
(vi) widening the Pudumanniar below Kittianai surplus ;
(vii) providing a separate side channel for Tandavankulam lands ;
(viii) widening the Vellapallam Uppanar from Uppan dam to the sea ;
(ix) improving the minor drains at the tail end of the Cauvery ;
(x) widening and deepening the Vettangudi drain ; and
(xi) disconnecting the Kittianai Uppanar from the Coleroon by cross-bunding it and diverting it into the sea south of Devikota, irrigating the tract so cut off either from the South Rajan voikal or from the Pudumanniar by means of a syphon.

8. Proposals (*c*) and (*d*) need no amplification, but the latter depends for its feasibility on the internal improvement of the Cauvery system itself.

9. I think we are all agreed that the crying need of the Cauvery is a thorough remodelling from top to bottom. The case has been clearly stated in the present Chief Engineer's note written on handing over charge of the circle, and Mr. Srinivasa Aiyangar makes out a good case for it in the report under review. His figures showing the comparative incidence of cost per acre in respect of internal improvements in the three big deltas speak for themselves.

10. Whether or not it is feasible to carry out the particular improvements recommended, without waiting for a general remodelling of the delta, is perhaps a question for consideration. If it be granted that the Vadavar has the first claim on our attention, matters will be somewhat simplified, since the irrigation on the South Arcot side is quite independent of the Cauvery delta proper. In so far as the Cauvery delta is concerned, then, there is no obstacle to the immediate application of the remedies proposed for the inherent defects in the South Arcot section of the Lower Anicut system. On the other hand it is doubtful if the particular measures proposed could be brought into effect without the Irrigation Act.

11. The same objection applies to the South Rajan voikal system, but apart from this the improvement of that system might be taken up simultaneously with that of the South Arcot section since the benefits to be derived from economy of water on both sides would be mutual.

12. When, however, we consider the question of definitely linking up this system with the Palavar, which is an integral portion of the Cauvery system, we must go warily. If the remodelling of the whole Cauvery Delta system is considered to be more than a possibility, we must look at the improvements proposed in connection with the Palavar and the large drains in this locality from a more comprehensive point of view or must defer them altogether until the remodelling of the Cauvery is investigated.

13. In any case I still maintain, as I did in my first report on this subject, that the Palavar system cannot in reason expect help from the Coleroon unless and until the inherent defects in the Lower Anicut system have been remedied.

14. With regard to the particular remedies proposed by Mr. Srinivasa Aiyangar, I have little to say. Those in connection with the irrigation appear to be in the right direction, viz., the abolition of unnecessary regulators and reduction of direct distributaries to a minimum. I have no personal knowledge of the drainage on the South Arcot side, but the proposals for the Tanjore side seem to be sound and feasible, though I am still inclined to think that it would be a great advantage if we could exclude tide water from these outlets, as originally proposed by me in the case of the Kittianai Uppanar.

15. I will not attempt to criticise Mr. Srinivasa Aiyangar's proposed modification of the sanctioned scheme for improvement to the head of the Vadavar ; the present Chief Engineer is thoroughly conversant with the question. I will only say that I deprecate any proposal to refrain from lowering the crest of the Lower Anicut throughout. This improvement will be of the greatest assistance to us in the difficult question of the exclusion of flood water from the delta.

16. I do not like the proposal to supplement the Palavar direct from the Cauvery by means of an offtake as high up as Vaduvagudi surplus *viâ* the Manniar. If the Manniar is to be an intermediary, it is already directly connected with the Cauvery by the Perumal Coil surplus, 13 miles further east, and irrigation under the Manniar itself does not begin until still further east, *i.e.*, at the " Uppan dam ".

17. The Manniar itself is badly in need of help and in time of short supply would not leave much for the Palavar, or rather the Pudumanniar. The Palavar itself is well enough served in its upper reaches and it would therefore be to the advantage of the Pudumanniar to receive its direct supply from the Cauvery at a point as far east as possible. The Vikramanar,

a large distributary taking off from the Cauvery 70 miles east of Grand Anicut, seems to be an ideal means of affording this direct supply. A mile's extension would bring it up to the point where the Ayyavaiyanar branches from the Palavar, a mile above the infall of the Manniar and about six above Uppan dam. It will be remembered too that Colonel Smart, in his Lower Cauvery Improvement project, provided a regulator across the Cauvery at Vikramanar head.

18. With regard to the Cauvery-Vennar morai question, which Colonel Ellis thought might be looked into by the Shiyali Investigation officer, Mr. Srinivasa Aiyangar has only implied that a revision of the morai would be a very round about way of supplementing the Palavar. No such object was contemplated by me when I made my proposals which affect the Vennar system equally with the Cauvery.

19. I do not know the result of the correspondence on the subject between the Superintending Engineer and the Collector, but the latter on hearing from the Superintending Engineer came to me for a note on the subject, a copy of which I append.

20. If an Irrigation Act may be expected in the near future the question of revision of morai may be allowed to lie over. With such an Act we would have the power to close sluices in the upper reaches when necessary, without which the full benefit of revision could not be secured. It is even probable that such power would render any revision unnecessary, while it is tolerably certain that with the construction of the Cauvery reservoir the question would not arise at all.

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*Note by the Executive Engineer, Tanjore division (for the Collector, Tanjore).*

The proposal to change the morai rules at the Cauvery-Vennar regulator emanated from me.

The present arrangement is two days exclusively to Cauvery, two to Vennar and three days divided between the two in proportion to the ayakats.

When water is very scarce the small quantities passing into the two rivers on "proportion" days is all absorbed in the upper reaches and this may even happen on morai days also.

My general proposal is to do away with the proportion days and distribute the available water during times of scarcity to each river in turn.

The exact method of distribution is a matter for enquiry and discussion.

The longer the period during which there is continuous flow in either of the rivers the better chance will the lower reaches have of getting some of it.

The practicable length of such period is limited by the length of time that the fields in the lower reaches of one river can remain without water while the other is receiving its supply.

I think there is no doubt that, other things being equal, a morai of three and a half days to each river in turn would be more beneficial than the present arrangement.

A morai of four days each might perhaps be even more beneficial, but the week is a very convenient period over which to spread the turns.

The Executive Engineer, Negapatam, has suggested an entire week to each river in turn but I doubt the practicability of this. The main morai is divided and sub-divided as the rivers ramify eastwards and some channels would only get, say, two days' supply out of the week's morai and of course none at all during alternate weeks, or in other words they would only get two days' supply in a fortnight.

The only real difficulty in the matter is the confusion that would be caused by the necessary revision of all the minor morais throughout the delta.

It must not be thought, however, that the present main morai is in any way fixed by custom. It is in fact only seven years old.

The Cauvery-Vennar regulators were built in 1886, before which date there was no morai.

In September 1886 rules for distribution at Cauvery-Vennar regulators were framed, but these did not include a morai.

Such an arrangement was first introduced in 1888–89 when the morai prescribed was that for three days all the water should be let down the Cauvery and for the remaining four days down the Vennar, and the Revenue Divisional-officer, Tanjore, asked for its renewal in his No. 1260, dated 15th October 1890.

This was revised in 1890, the morai then laid down being that the Vennar was to be closed every Friday and Saturday—*vide* Collector's No. 8918, dated 22nd December 1890.

The morai now in force was finally introduced in 1899.

The ryots presumably adapted their minor arrangements to the several changes in the main morai and could therefore presumably do so again.

As far as I have been able to ascertain, any reasonable *lengthening* of the morai period would be welcomed by the ryots in the lower reaches of the Cauvery. About the lower reaches of the Vennar system I am not in a position to give an opinion.

I do not think it feasible to close the sluices in the upper reaches of the Cauvery for the benefit of the lower in the absence of an Irrigation Act.

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## *Preliminary Report on the Shiyali Water-supply Investigation.*

*Introduction.*—The water-supply to Shiyali, which forms one of the coast taluks of the Tanjore district, has from very early times been far from satisfactory and various improvements have from time to time been effected both by the British Government ever since its advent into the district and by the early Hindu kings prior to that period. The extent to which it has been improved can be seen from the early history of the "Cauvery Delta System".

2. *Description of the Cauvery system.*—The Cauvery, or more correctly the Aganda Cauvery, branches into two at the head of the island of Srírangam about 10 miles to the west of Trichinopoly. The northern branch called the Coleroon runs north-eastward more directly to the sea along the northern limits of the Tanjore district; the southern branch or the Cauvery flows eastward and enters the Tanjore district near Koiladi where it divides into two, the Vennar and the Cauvery which in their turn divide themselves into several main and minor branches to irrigate the whole of the delta. Below the island of Srírangam a small stream known as the Ullar connected the Cauvery with the Coleroon running close by, but on a lower level.

*Origin of the Grand Anicut.*—This stream in course of time developed to big dimensions and starved the delta of nearly all the supply that would have entered it in ordinary days, by diverting it into the Coleroon. Temporary expedients were adopted at first to stop this drain and subsequently a masonry dam known at present as the Grand Anicut was constructed across it by one of the Chola kings then reigning in Tanjore. The Cauvery after this began to silt up heavily at the head above the island of Srírangam and the larger portion of the supply available when the river ran low, entered the Coleroon, whose bed was lower and fall greater. Heroic efforts were made to restore the supply to the Cauvery by removing the silt at the head, by constructing small dams of stone and earth across the Coleroon, and by opening sand sluices in the body of the Grand Anicut; but not with much success. The water-supply to the delta continued to diminish and the extent of land under irrigation yearly decreased. This closes the first chapter in the history of the delta, in which Shiyali suffered from defective supply in common with the delta but more acutely.

3. *Origin of the Cauvery dam.*—During 1836–38 a masonry dam was constructed across the Coleroon at its head and the supply to the delta was restored. But it was subsequently found to have the effect of scouring the bed of the Cauvery very badly and of throwing a greater supply into it than was desirable. To counteract this a similar dam was built in 1846 across the Cauvery, to its ordinary bed level and a calingula 150 yards long was opened in its left bank two miles below to discharge back into the Coleroon any extra water that might have entered at its head. These improvements succeeded fairly well in sending enough supply into the Cauvery when the river had a normal flow, but were not effective in preventing a large volume of water from rushing into the delta through the Cauvery and its branches and doing immense damage to crops and lands below.

4. *Origin of the Lower Anicut and its systems.*—In 1836 almost simultaneously with the Upper Anicut, another work was constructed across the Coleroon 67 miles lower down known as the Lower Anicut where existed, from very early times, a channel by the name of the Vadavar to supply the Veeranam tank, one of the largest tanks in the Presidency, and irrigating a large extent of land in the South Arcot district, the primary object of this channel being to compensate the tank for its loss of supply due to the construction of the anicut at the head of the delta. Advantage was also taken at the same time to provide a supply of water from the Coleroon for the north-eastern portion of the Tanjore district, which was either beyond the influence of, or was indifferently supplied by the tail ends of the Cauvery channels. Accordingly channels were taken from both sides of the Coleroon at the Lower Anicut, one for Chidambaram taluk in South Arcot, under the designation of the North Rajan Voikal, and the other, for Shiyali taluk under that of the South Rajan Voikal.

5. *The Manniar.*—About 27 miles above the Lower Anicut another channel known as the Manniar was taken from the Coleroon, with a sluice at its head, to supplement the supply to lands in a portion of the Kumbakónam and the Máyavaram taluks which were receiving an indifferent supply till then from the Cauvery channels or were beyond their influence.

6. All these improvements, which formed the second stage in the development of the project, secured a better supply at the head of the delta, when the river was normal and supplemented lands at the tail end which were till then indifferently served by the Cauvery channels. They were, however, not comprehensive enough to establish the control over flood water necessary to

prevent it from entering the delta unchecked and doing great havoc. Evidently it was then thought too early to undertake to improve the system as a whole internally, to facilitate equitable distribution of water within the delta, and to provide efficient drains to minimise loss due to submersion caused by local rains and floods in the river.

7. *First steps taken to exclude floods from delta.*—The condition of the delta still continued to engage the attention of the Government. During the sixties the practicability of impressing the Coleroon into the service of the Cauvery with a view to relieving the latter of its flood waters before entering the delta, was enquired into by special officers deputed for the purpose. It was then found that only partial relief could be given; that the Coleroon would not be able to receive into it a high Cauvery, specially when the latter got complicated with floods due to local rains, from the basin draining into it between the Upper and the Grand anicuts; that the Cauvery would fail to receive any relief when the Coleroon became congested with floods due to local rains from the basin draining into it between the Upper and the Lower anicuts; and that the destruction of the delta would be almost certain, should the Cauvery floods happen to coincide with heavy local rains in the basins abovementioned—a combination of circumstances, however, which past experience does not warrant one to expect.

8. *Improvements at Grand Anicut.*—Regulators were however built in 1886 across the Cauvery and the Vennar to control the supply into the delta and to relieve it of flood water whenever it was found possible to do so. The construction of a set of surplus sluices in place of the Grand anicut to improve still further the control on such occasions was also advocated.

9. *Deterioration in Shiyali.*—During this period the supply to the Shiyali taluk in spite of the improvements already effected continued to be unsatisfactory. The help given to it by the South Rajan Voikal had proved insufficient; and the Manniar had failed to give that additional help it was expected to afford, on account of much accumulation of silt at its head and along its bed.

10. The internal distribution of water in the delta had gone from bad to worse and the supply from the Cauvery to channels at the tail-end had proved more unsteady. The Palavar (known in its lower reaches as the "Pudumanniar") which formed the main source of supply to the Shiyali taluk and depended on the drainage from lands irrigated by the Manniar and the Cauvery in its lower reaches, had failed to receive an adequate supply from drainage. The helpless condition of the taluk as regards irrigation Colonel Oakes described in his report printed with G.O., No. 1894, dated 16th June 1866, thus:—"Five feet of water over the Cauvery dam ought to afford full and sufficient supply to irrigation dependent on the Cauvery. The first great branch from the Cauvery is the Vennar and though the cultivation before the point of bifurcation under the rivers bears the proportion of 9 to 10, the waterway over the respective dams is nearly 7 to 4, so that the Cauvery receives far more than its share of water, and yet owing to the defective state of the river the Māyavaram taluk does not receive a sufficient supply unless 7 feet of water are flowing over the Cauvery dam or until the district is receiving nearly double the supply it ought to require, and even then a portion of Shiyali taluk receives but a scanty supply."

11. *Lobb's investigation of Lower Anicut system*, 1886.—An investigation was ordered in the eighties to propose such improvements to the Coleroon as would render it safe to take in an emergency as much as 300,000 cusecs and to suggest the best means of giving further additional supply to Shiyali. The officer in charge advocated the advisability of drawing the necessary supply from the Coleroon from above the Lower Anicut after examining the discharge of the river from 1865 to 1885. He proposed to improve the channels taking off from above the Lower Anicut; to provide for greater storage in the Veeranam tank by raising its F.T.L. by 2 feet and thus minimising as far as possible the demand of water for South Arcot during periods of low supply in the river, and to benefit further the Shiyali taluk by forcing an additional supply through the South Rajan Voikal and the Kumukkumanniar by improving them, and dropping it into the Palavar or Pudumanniar, the main irrigation source of the taluk.

12. *Colonel Smart's reinvestigation*, 1894.—No action was taken on this till 1894 when Colonel Smart was placed on special duty to enquire into the defects of the delta as a whole and suggest improvements. After detailed investigation he thought it safer to reduce the maximum discharging capacity of the Coleroon to 250,000 cusecs and to distribute any excess over this quantity, when the Cauvery was in maximum flood, among the different rivers running through the delta according to their respective capacities, taking into consideration at the same time the effects of abnormal rains falling within the delta. Such a complicated distribution could not have been rendered possible but for the perfect control he gave to head works by introducing his large lift shutters, capable of being raised or closed with perfect ease. After removing the permanent obstructions to the free flow of floods caused by the existence of solid masonry dams in the Upper, Grand and Lower anicut works, he had the flood banks of the Coleroon raised to carry safely the maximum floods, and arranged for the careful conservation of the river by special establishment. He formulated and submitted proposals for improving the drainage of the delta, which he would have made more thorough had he been sure of larger funds for their

execution. Two of the above schemes are now in progress and the others are held in abeyance till the advantages of the above works are clearly demonstrated. He had no time, evidently, to investigate the internal distribution of water for irrigation rendered highly complicated and difficult to deal with by the absence of an irrigation cess law.

13. The supplementing of the Palavar or Pudumanniar from the Coleroon from above the Lower anicut also engaged his attention. He accepted the advisability of utilizing the South Rajan Voikal and the Kummukkumanniar for the purpose but was not at the same time convinced of the necessity for such a course as he thought that the Palavar would be full when the Coleroon had any supply to spare and that during such times the former would be able to replenish itself without fresh works directly from the Cauvery, which would also be then more than full. He also suggested for consideration the advisability of giving a direct supply to the Palavar when found necessary, by converting the old lock above the Lower anicut into a sluice with its cill at $2\frac{1}{2}$ feet below the top of the existing shutters, by improving and utilising the existing old channel (three miles long) from it to the Manniar near Thirupanandal and by excavating a new channel in continuation for another three miles among wet fields, after crossing the Manniar and other irrigation channels on the way by means of suitable masonry works.

14. *Special investigation of Vellar, Veeranam tank, etc., in* 1902.—About 1902 an investigation was started under the control of a special Superintending Engineer with a view to connecting the Lower Coleroon anicut system with the Shatiatope anicut system, after improving the Veeranam tank by raising its F.T.L. by two feet; supplying the Vellar, which is fed by north-east monsoon rains, from the Coleroon during July and September when the latter is in floods, and increasing the extent of irrigation under the Vellar. This scheme has recently been sanctioned for execution in G.O., No. 944 I., dated 1st September 1906.

From these facts it can be seen that during the past century the improvements done to the Cauvery delta were confined to perfecting the control at its head over the floods of the Cauvery and that other improvements within it have practically been neglected. Proposals there had been for improving the drainage of the delta, and for supplementing from the Coleroon the defective supply in Pudumanniar, which forms the main source of irrigation to the Shiyali taluk, but they have not advanced beyond that stage. The internal distribution of water for irrigation among the various main and minor channels still remains in its old unsatisfactory state and complaints of defective supply to tail-end lands are increasing in bitterness. The proposal to construct a reservoir across the Cauvery to replenish it when its supply diminishes and becomes unequal to the demands of cultivation dependent on it, will no doubt improve matters, but this can only be done with considerable wastage of water stored at a heavy cost, unless the internal distribution of water for irrigation is perfected and unless sufficient relief from loss due to submersion is given by improving the efficiency of the existing drainage courses in the delta.

15. *The present investigation.*—The subject of defective irrigation in Shiyali taluk, though disposed of in a way, was not allowed to be dropped and the ryots persisted in pressing on the Government their claims for improvements and praying for relief. The Government finally in its order No. 1780 W., dated 24th August 1906, ordered its detailed investigation by a special establishment working under the orders of the Executive Engineer, Tanjore district.

16. *Description of Shiyali.*—Shiyali is the north-easternmost and smallest taluk of the Tanjore district. It has an area of 109,248 acres and is bounded on the north and west by the Coleroon, by Máyavaram on the south and west and by the sea on the east. It contains more wet land than dry, situated as it is in the delta of the Cauvery, but this is not generally of the best kind, because the irrigation channels of the Cauvery have deposited most of their fertilising silt before they reach this tract. The bulk of the soil, however, is alluvial.

17. *Rainfall.*—The average annual rainfall (for the years 1870 to 1903) recorded at Shiyali is 53·83 inches—a fall fairly high for an East Coast station—with a maximum of 89 inches in 1885. Its distribution during the several months of the year, viz. :—

| | | | |
|---|---|---|---|
| January ... ... ... | 1·09 | July ... ... ... ... | 2·70 |
| February ... ... ... | 0·54 | August ... ... ... | 4·56 |
| March ... ... ... | 0·26 | September ... ... ... | 4·76 |
| April ... ... ... ... | 0·77 | October ... ... ... | 9·79 |
| May ... ... ... ... | 1·75 | November ... ... ... | 15·89 |
| June ... ... ... ... | 1·61 | December ... ... ... | 10·11 |

shows that most of the rainfall is received during the north-east monsoon which strikes directly on the East Coast taluks north of Point Calemere, where the average fall is consequently much higher than in the interior and the more sheltered parts of the coast. Thus during certain portions of the irrigation season, the wet portion of the taluk can, with the help of north-east rains, which are generally regular, be made practically independent of any supply from the delta channels. The Cauvery can be made to spare enough water to Shiyali during July, August and September, when it is in steady freshes, to enable it to begin its cultivation earlier than is at present the case, provided the internal distribution of water among the various minor channels is improved.

18. *Distribution of water in the delta.*—The distribution of water among the major distributaries is in the hands of the Public Works Department and the control of supply into these has been successfully effected by the several important regulators recently built across them. But the distribution of water among the smaller channels still remains in the hands of the ryots and is generally controlled by morais ratified by long usage, according to which, during times of scarcity, channels get water by turns for proportionate periods. Where mutual arrangement cannot be made, the ryots are induced to acquiesce in the construction of dividing dams to permanently apportion the water, but such means of regulation are rather the exception. It often becomes difficult to intervene even for the benefit of all parties concerned without running counter to some "mamul" or immemorial usage to which the ryots cling with stubbornness and which the Civil Courts must generally support. The disadvantages of this system are that much water is apt to be wasted by intrinsic faultiness of the system of morais and that injustice is often perpetrated by the unfair management of the system by the more violent and influential ryots. Though the supply at the head of a river is very often more than practically adequate for the area depending on it, yet on account of the uncontrolled waste above referred to there is always an apparent scarcity in the lower reaches of many of the river channels even under the most favourable conditions.

19. *Defective drainage in the delta.*—The improvement of internal distribution unless followed by efficient drainage cannot by itself effect much good, though this may sound paradoxical. After the Cauvery has been filled for some little time every year, the whole of the tail-end of the delta tends to become water-logged and liable to submersion as the very gradual slope of the ground towards the sea makes it difficult for all the water required for the irrigation to run off easily. This evil is accentuated by the unusually heavy rainfall which is received by the taluk during the north-east monsoon. No doubt this could be minimised to a certain extent by a distribution of water which would be more scientific both as to quantity and time than has been evolved by the immemorial usage described above. Much has already been done by the restriction of the unnecessary quantity of water that was formerly allowed into the delta. But this source of evil is still far from removed, and the Cauvery Delta system cannot be said to have been perfected till substantial improvements in the matter of providing efficient drainage and more equitable distribution of irrigation water in the distributaries are effected.

20. *Description of Shiyali irrigation.*—Shiyali taluk has 58,245 acres of wet land and these are irrigated by the South Rajan Voikal, the Cauvery and the Palavar or Pudumanniar. The South Rajan Voikal which branches from the right flank of the southern branch of the Lower Anicut, irrigates at present about 17,027 acres, of which more than 14,000 are in the Shiyali taluk. The whole of this extent is generally considered better supplied than other parts of the taluk and its cultivation begins more than a month earlier. Great wastage of water takes place under this channel, the total quantity used being nearly twice as much as is necessary. The improvements considered necessary to minimise the wastage and make the channel work to a higher duty will be proposed when dealing with the supply of water available at the Lower Coleroon anicut.

21. The Cauvery at its tail-end irrigates about 6,000 acres in Shiyali taluk, which extent gets little or no supply at the beginning of the irrigation season, even when the river runs more than full at its head.

The ryots, therefore, generally wait for the monsoon rains to begin cultivation. But the defective drainage often damages young crops on the fields by submerging them during October and November, when the river is generally in flood and the monsoon rains are heavy. Thus the average yield per acre from these lands is not estimated by the Revenue Department at more than 66 per cent. of that from lands under the South Rajan Voikal. The supply to these lands it is not possible to improve till the distribution of water among the various distributaries in the higher reaches of the Cauvery is controlled more efficiently and the channels themselves improved to work to a higher duty. This must necessarily be a work of some years.

22. The Palavar or Pudumanniar, which forms the main source of supply to the taluk, irrigates 38,000 acres or about two-thirds of the total area. A few small drainages above Swamimalai in Kumbakónam taluk join together and form the Palavar which name it takes from below the Ottai Vaikal calingula on the right bank of Ganganadapuram channel, an off-take of the Cauvery. It assumes larger proportions in its lower reaches as it receives local drainages *en route*, traverses the Kumbakónam, Máyavaram and Shiyali taluks and escapes over the Uppan dam into the Vellapalem Uppanar, which after a winding course enters the sea near Tittai or Tirumalaivasal. The total length of the river from source to Uppan dam is 41 miles and its drainage area 146 square miles. It thus not only forms an important drainage but also irrigates a large extent of land in its first reach (in addition to what it does in Shiyali) with the aid of a series of dams, all of which are being converted into open regulators to offer as little obstruction as possible to the passage of drainage during the rainy season, under an estimate sanctioned two years back. During the forties a branch was taken from the tail end of the Palavar, under the name of Pudumanniar, to irrigate Pudupatnam and Thandavankulam villages which were then a forest, lying near the mouth of the Coleroon. This channel was subsequently improved to irrigate all villages on the way, and the irrigation under it now amounts to more than 19,697 acres. It was found that the supply in the Palavar was insufficient and that about 1,200 acres of land in Gopalasamudram and other villages were too high to be commanded. A regulator

was consequently constructed at Puthur across the Pudumanniar, near the road bridge 2 miles below Anaikaranchattram, and the South Rajan Vaikal was made to give it a supply for a day and a half per week through Aravathumakatlai channel branching from above the Vadarangam calingula. A regulator was also built just at the head of the Pudumanniar known as the Mukkuttu regulator with the object of raising water to Kaluamaliar, a branch of the Pudumanniar irrigating 6,009 acres lying to the south. After some time it was found that the first regulator was built too far down the channel. It was therefore shifted to its present site near Gopalsamudram, and the period of closing it was reduced to two days a week from the original 2½ days and the supplemental supply from South Rajan Vaikal was given through the Oosi Vaikal, a branch of the South Rajan, instead of through the Aravathumakatlai as before.

23. Such an important river as the Palavar, irrigating in all about 54,636 acres, has not got a direct source of supply either from the Cauvery or the Coleroon. The Manniar, an off-take from the Coleroon, which had been replenishing the Palavar before it entered the Shiyali taluk, had failed. The supplementary supply given from the Lower anicut through the Kummukkumanniar, which dropped its supply into the Manniar a few miles above its junction with the Palavar, was comparatively too little. The surplus from the tract of country fed by the Cauvery and the Manniar, and which drained into the Palavar did not become sufficient till nearly the whole of that extent was cultivated. Thus the Palavar had no adequate supply till September to start cultivation, and the north-east monsoon, which sets in immediately after, filled the river to overflowing, breached its banks and damaged the young crops by frequent submersion. It is also a notorious fact that villages at the tail end of the Pudumanniar often begin their cultivation in December and continue their irrigation season up to April and May with the help of a special morai (turn) given to them from the South Rajan Vaikal through the Oosi Vaikal.

24. The statement (enclosure A) (statement showing the Number of days the Coleroon can supplement the Pudumanniar) accompanying the report, shows the number of days of deficient supply in the Pudumanniar during the period July—January for a series of years, assuming that the channel is worked to a duty of 66 acres per cusec.

25. The state of irrigation in Shiyali taluk under the Pudumanniar, Mr. Thomson, then acting Collector of Tanjore, describes as follows in his Rev. No. 697, dated 31st July 1893, " . . . want and insufficiency of water with other grave reasons was the general complaint in the Shiyali taluk . . . . similarly the villages towards the south-east corner supplied by the Pudumanniar and Aiyavayanar of the Cauvery always suffer, then water runs at all short. In fact below the Putur dam on the road 2 miles from Anaikaranchattram all complain to me of how injuriously it had affected their supply and the outturn whereas the Rajan Vaikal is the most certain irrigation in the district running late in the year . . . . and when it (the silt bearing Cauvery water) has stood on the fields and passes off as drainage water to lower lands by universal consent and manifestly it is not the fertilising agent that it was on entering the delta . . . . During jamabundi I interrogated the village officers as to the outturn of the present time as contrasted with the Olungu standard of production. In Shiyali in the villages protected by the South Rajan Vaikal the yield was invariably equal to the olungu, and in the lower rated lands was in excess of it; whereas under the Pudumanniar, the other main source, it was not uncommon to find a falling off of a third, a fourth, a fifth or a sixth, the latter two being very common, the difference being the widest in the highest rated lands ".

26. *Description of Shiyali drainage.*—This taluk, though not the only one in the delta in this respect, cannot be said to possess an efficient system of drainage. A small portion of it, lying to the right of the South Rajan Vaikal drains directly into the Coleroon, while the major portion drains into the sea through the Vellapalam Uppanar, the Kittianai-Uppanar and Vettangudi Vadigal, which may be said to form the main outlets of the system.

27. The Vellapalam Uppanar, which takes its name from where the Palavar surpluses over the Uppan Dam, drains the southern portion of the taluk, 50 square miles in extent, in addition and enters the sea near Thirumalavasal. The construction of a set of low level surplus sluices (now in progress) in addition to the existing escape must inevitably congest the drain and prolong the period of submersion of lands on both sides of it, unless it is considerably improved.

28. The Kittianai-Uppanar which receives the surplus of the Pudumanniar in the limits of Palayapaliem, is joined by several other drainages. It drains the tract of country between the Railway line, the Pudumanniar and the South Rajan Vaikal, about 24 squares miles in extent. It had prior to 1896 a direct outlet into the sea near the mouth of the Coleroon about 4½ miles to the north of Devakotta and formed an efficient drain until the Coleroon breached into it and made for itself a third outlet direct to the sea, near the village of Puduppatnam immediately to the south of Devakota. Since this breach the tail villages have found it difficult to drain directly into the Coleroon and got submerged, often for days together, when the Coleroon is in flood.

29. The Vettangudi Vadigal drains an equal extent to the right of the Pudumanniar lying between it and the sea. It is said to have never been effective, for want of a proper and sufficient outlet into the sea, and to cause frequent submersion and damage to lands at its tail-end.

30. Suggestions for the improvement of the supply in the Pudumanniar and the main drainage courses will be dealt with in paragraph 39.

31. *General proposals for improvement of supply to Shiyali.*—It has been the experience of many who have studied the needs of the delta, that the Cauvery proves very often unequal to the demand on it except when it happens to be in freshes. Any scheme therefore calculated to improve the supply to lands that are now deprived of it, as naturally to assume the supply available at head to be carefully conserved and distributed equitably and economically among the various main and minor distributaries within the delta, after improving and regrading them to suit the work expected of them. Shiyali therefore which is at the tail-end of the system, has naturally to wait for the remodelling of the delta as a whole, before hoping to better its defective supply, which must from its magnitude be a work of years. But in the meantime, a major portion of it can be given the benefit of tolerably uniform supply immediately by tapping a portion of the surplus of the Coleroon that now runs to waste to the sea at the Lower Anicut. This proposal was investigated in detail by Mr. Lobb in 1886 and reported upon in his letter No. 258, dated 19th June 1886, printed as an appendix to G.O., No. 523 I., dated 8th May 1902. He enquired into the supply available at the Lower Anicut from 1865 to 1885 and suggested that there was enough water to spare for Shiyali, after supplying the existing irrigation under the system. But the recent improvement to the Upper works at the head of the delta and to the Lower Anicut and the construction of the Cauvery-Vennar regulators have necessitated a fresh enquiry. An attempt has now been made to infer what the effect of these improvements would have been on the supply available ever since 1886 in order to have sufficient data to build proposals on. The quantities surplused over the Upper, Grand and Lower Anicuts have been ascertained and also the combined discharges of the Cauvery and the Vennar. In compiling these, the discharges of the Cauvery and the Coleroon tabulated by Major Montgomery some 30 years ago have been assumed, and also those of the Vennar and Cauvery, determined a few years ago in the Tanjore Division. These would no doubt affect the result arrived at, but it is believed not to such an extent as to diminish their importance. The Kumukkumanniar and the North and South Rajan Vaikals and the Vadavar, which take off from the Lower Anicut, have now been gauged with velocity tubes for every foot of their depths and tables constructed to determine their discharging capacities at different depths (*vide* enclosures J to M). (*Enclosure J.*—Statement of discharges of the North Rajan channel. *Enclosure K.*—Statement of discharges of the Vadavar. *Enclosure L.*—Statement of discharges of the South Rajan channel. *Enclosure M.*—Statement of discharges of the Kummukkumanniar).

32. *Investigation of supply available at Lower Anicut.*—From these, statements of supply available at the Lower Anicut have been prepared. It has been assumed that any discharge into the Cauvery and Vennar taken together in excess of their full supply, determined at a duty of 44 for the former and 66 for the latter would be diverted into the Coleroon to swell the supply available in it prior to the remodelling of the Anicuts, while any deficiency would likewise diminish the supply available at Lower Anicut provided the surpluses over the Upper and Grand Anicuts either equal or exceed the total deficiency.

33. In this, the effect of the Vaduvagudy and Perumal Coil surpluses situated in the Cauvery considerably below the Coleroon and Vennar regulators have not been considered, as they are generally kept closed during the irrigation season unless the main river happens to be in freshes, while their effect on the Coleroon will be insignificant when compared with the volume the latter would be then carrying.

34. The supply available at the Lower Anicut has been made up by adding the surplus over it to the discharges of the channels taking off from it. From the results so obtained the supply required for the existing extent under the Lower Coleroon Anicut system calculated at a duty of 66 acres per cusec has been deducted, as below, and the balance shown as available for use elsewhere—

| | ACS. | CUSECS. |
|---|---|---|
| *Tanjore.* | | |
| South Rajan ... | 17,025 | 258 |
| Kummukkumanniar ... | 1,280 | 19 |
| *South Arcot.* | | |
| North Rajan ... | 18,856 | 286 |
| Vadavar ... | 10,603 | |
| Veeranam tank ... | 39,451 | |
| Khan Sahib's canal ... | 12,946 | |
| Shattiatope anicut system ... | 34,000 | |
| Total ... | 97,000 | 1,470 |
| Total ... | | 2,033 |
| | | say 2,040 |

Another statement has been prepared showing the extent of supply available in the Palavar or Pudumanniar which forms the main source of supply to Shiyali taluk, and which it is proposed at present to supplement from the Lower Anicut. The effect of rainfall over the area irrigated has also been considered when determining the necessity for help from outside. The site for gauging the discharges of the Pudumanniar was chosen below the Mukkuttu regulator, the only place where the records available could be made useful for the purpose, though nearly half the extent which is said to feel the defective supply lies above this point. It has therefore been assumed for want of any reliable information that on days when the supply was defective below the regulator there was also a proportionate deficiency above that point. From these data a final statement (enclosure A) (Statement showing the number of days the Coleroon can supplement the Pudumanniar) has been prepared, showing the number of days in each month of the irrigation season during which the Palavar or Pudumanniar wants help, and the number of days the Coleroon can be depended on to provide it. The number of days Cauvery will be able to help has also been noted, on the assumption that when full supply is available at the head it is capable of sparing to the Palavar its legitimate share, which it wastes at present in the higher reaches, evidently owing to defective control over distribution.

35. The final statement (enclosure A) (Statement showing the number of days the Coleroon can supplement the Pudumanniar) thus prepared shows that the advantages of supplementing the Palavar either from the Cauvery or the Coleroon are almost equally balanced. The former entails the remodelling of the whole delta and even then it would be problematical to send down adequate supply to the tail-end lands of Shiyali at the commencement of the irrigation season, though a channel from it to supplement the Palavar would be only about two miles long if taken from above the Vikramanar head. A channel on the other hand from the Lower Anicut would cost more but would have the inestimable advantage of supplying Shiyali almost at the same time as the Cauvery does the lands in its first reach—a material point in its favour.

36. *Discussion of duty.*—The help it is proposed to give from the Coleroon is based on the assumption that the distributaries under the Lower Anicut system can be worked to a duty of 66, and those under the Cauvery and Vennar to 44 and 66, respectively. But that, under the existing condition of distribution and the bad state of distributaries it is not possible to attain even this low duty, is evidenced from the statements (enclosures V to X). (*Enclosure V.*—Statement showing the average discharge and duty of the North Rajan Vaikal of the Lower Coleroon Anicut system. *Enclosure W.*—Statement of average existing supply with the duty arrived: Cauvery Delta system. *Enclosure X.*—Statement showing the average discharges of Cauvery, etc., after the construction of the Reservoir and duty attained) annexed wherein the actual duties worked to are shown. The supply at the head is at present generally made to depend more on the state of the river than on the needs of irrigation and the apparently high average duty attained in spite of the enormous waste the present methods involve, is due chiefly to the supply in the main source falling considerably short of actual requirements during November, December and January. In the deltas of the Gódávari and the Kistna, where the average duty is above 100 and the duty during periods of maximum supply rarely goes below 70, great wastage is said to exist and a vigorous policy of regrading and remodelling of the distributaries (which must be said to be in excellent condition when compared with what they are in the Cauvery delta) is advocated as profitable. A similar policy, if adopted in the Cauvery delta, should prove under the existing circumstances considerably more profitable. The recent proposal to work the rivers of the delta to a considerably higher duty, after the construction of a reservoir across the main river (*vide* statement enclosed X) (statement showing the average discharges of Cauvery, etc., after the construction of the Reservoir and duty attained) would prove highly problematical, if the improvements abovementioned were neglected, as they have been. But the peculiar conditions prevailing here render a proposal to work the distributaries to a considerably higher duty than elsewhere, and extend the benefit of the project to tracts which are now beyond it without in the least affecting the supply to existing cultivation a very promising one. July to September are months when cultivation is in progress and demand for water is at a maximum and the Cauvery also is invariably in high freshes at this time very often carrying a considerable volume of water, and being thus in a position to spare water for extension. October, November and a portion of December at times bring heavy rains due to the north-east monsoon, which practically render the delta independent of artificial supply. December and January are months when the river runs very low though there is still demand for water. The state of the crops however and the commencement of the harvest on the fields first cultivated, reduce the demand to the lowest possible limits. Taking all these facts into consideration, I have ventured to append a statement (enclosure T) (Statement showing average duty each month and that can be attained if supply is regulated according to demand) in which the total supply for a crop of rice has been fixed at 60 inches distributed among the seven months of the irrigation season (July—January) according to its existing needs. This supply should prove more than ample, even after making liberal allowance for all sorts of wastage, and the experiment carried out during the seventies in the South Arcot district and in America over extensive regions, where hygrometric conditions are less favourable, demonstrate that a total supply of 32 inches, 36 inches is sufficient to induce an ideal growth. To be on the safe side, I have also assumed that it is possible to utilise only half the amount of rainfall during the period, October

to December, when the north-east monsoon rains are heavy. Even with these restrictions, the average supply required from the river for a crop of rice does not exceed 36·70 inches and the average duty does not fall below 112, even after allowing a further 20 per cent. for wastage in distribution. The duty attained during the period July—January is as noted below :—

| | |
|---|---|
| July ... ... ... ... ... ... ... ... ... | 126 |
| August ... ... ... ... ... ... ... ... | 97 |
| September ... ... ... ... ... ... ... ... ... | 74 |
| October ... ... ... ... ... ... ... ... ... | 187 |
| November ... ... ... ... ... ... ... ... ... | 280 |
| December ... ... ... ... ... ... ... | 182 |
| January ... ... ... ... ... ... ... ... ... | 243 |

A reservoir across the Cauvery like the one proposed would greatly facilitate the attainment of this object by correcting the irregular supply in the river during intervals between freshes and by supplementing the deficiency in the river during December and January.

37. *Internal improvements proposed, Tanjore side.*—I shall confine myself in this report, therefore, to internal improvements in the channels of the Lower Coleroon Anicut system, on which the bettering of water-supply to Shiyali taluk is more dependent at present, and leave the wider subject of improving the delta for future investigation. These improvements when carried out would enable the Coleroon to spare enough water to supplement the Palavar or Pudumanniar in ordinary days by stopping the existing large wastage under the various channels of the system. The Kumukkumanniar and the South Rajan Vaikal on the Tanjore side, and the North Rajan Vaikal and the Vadavar on the South Arcot side, are the channels that take off from above the anicut.

(*a*) *The Kumukkumanniar.*—This is an off-take from the right bank of the southern branch of the Coleroon to irrigate 1,280 acres of high level land bordering on the South Rajan Vaikal in its first reach and to a certain extent helps the Manniar by supplementing it whenever practicable. The southernmost vent of the South Rajan head sluice is utilised to admit supply into the Kumukkumanniar when the drainage from lands served by the Manniar which enters the channel near its head, proves insufficient. It is 8 miles 1 furlong 330 feet long, about 10 feet wide on an average, and has a fall rarely exceeding 6″ per mile. It has silted up uniformly throughout its length, the depth of silt at the head being about $3\frac{3}{4}$ feet. It has, when running full, a velocity not exceeding 2 feet per second and receives no fresh deposit. It has a few outlets on its left bank to surplus the excess supply in it into the South Rajan Vaikal or the Odiyar. It crosses three drainage courses by masonry aqueducts and has a syphon under it to lead the drainage of a small extent at its tail end to the South Rajan Vaikal. In his proposal to supplement the irrigation under Palavar, Mr. Lobb urges the advisability of turning into the Kumukkumanniar a supply of 122 cusecs to be dropped into the Manniar a few miles above its junction with the Palavar. The extent of land proposed to be supplemented thus is 16,576 acres excluding the Kalumalyar which has 6,009 acres under it, and which he would help along with other lands below the Mukkuttu regulator, from the South Rajan through the Oosi voikal. But the carrying capacity of the channel has to be increased to 144 cusecs, according to his estimate of requirements (viz.) 2 cubic yards per hour per acre for lands directly dependent on the channel ($66\frac{2}{3}$ duty) and half of that for lands to be helped ($133\frac{1}{3}$ duty). The disadvantage of running with such a large amount of varying supply as it becomes available into a channel, whose needs for the irrigation under it rarely exceed 20 cusecs, is obvious. This proposal becomes still more impossible when the necessity for doubling the supply during the commencement of irrigation when the drainage entering the Palavar on which it solely depends is practically very little, is considered. The only satisfactory way by which this can be avoided seems to be to have a separate channel with a new head sluice to the right of the Kumukkumanniar big enough to carry all the supply necessary for the Palavar and the Pudumanniar, and to dorp it into the Manniar just above the infall of the Kumukkumanniar. This would lead the South Rajan Vaikal and the Kumukkumanniar as they are at present.

(*b*) *The South Rajan Vaikal.*—This channel is taken from the right bank of the southern branch of the Coleroon above the Lower Anicut with a sluice at its head, and irrigates 17,027 acres, more than 14,000 of which are situated in Shiyali taluk. It is about 28 miles long, is of varying width and very crooked in many places, has a depth of 6 feet when flowing full and discharges 445 cusecs representing a duty of 38 acres per cusec. It has two masonry calingulas built across it to raise water to high level lands near them: the first is at 12 miles 4 furlongs and has recently been remodelled and fitted with shutters worked by rack and pinion arrangements. This is closed for a day and a half per week, to irrigate lands of Sidhamalli village about 600 acres in extent. The second is at 17 miles 4 furlongs immediately to the south of Vadarangam village and is an old work with $2\frac{1}{2}$ feet of upright stones built into it. It is closed for one day in the week to benefit lands of Vadarangam Elathur and shrotriem about 600 acres in extent which are said to be on a high level. When the supply in the Coleroon falls low, the channels from the Lower Anicut themselves are put in "turns" and by this arrangement the South Rajan Vaikal fails to get any supply for another two days in the week. Thus during periods of scarcity the South Rajan Vaikal below the second calingula, which has nearly half the ayakat under it, can be said to enjoy nominally a turn of $2\frac{1}{2}$ days a week which in

practice gets reduced to two days on account of the interval of half a day that is allowed to intervene between the end of the turn at Sidhamalli calingula and the beginning of the turn at the lower anicut. The lands under Vadarangam calingula also do not get the full benefit of a day's turn as it is allowed to be closed immediately after the turn at the lower anicut and the water takes nearly half a day to reach the calingula. All these facts account for the apparent scarcity of water in the lower reaches, of which complaints are heard frequently. Many main and minor branches take off from the South Rajan Vaikal but only a few of them have been provided with sluices at their heads. It crosses many drainage courses, the most important of them, the Odaiyar and the Kondappan-Cauvery being crossed by masonry aqueducts known as the Marimudukku and the Kondappan-Cauvery aqueducts respectively, the rest are taken under the channel by means of syphons. A few more drainages enter the channel, one of them below the Sidhamalli calingula near the village of Kuruchi, draining about 2·84 square miles, and this is run into the Coleroon through the surplus work at the 16th mile known as the Vannan-odappu. The Alungiyar and the Olai Vaikal are also taken in and surplused into the Coleroon by means of outlets in its left bank one of which requires to be improved.

The faulty alignment of the minor channels without reference to the level of fields to be irrigated, and indiscriminate conversion of dry fields on a high level into wet which after a few years are classified as "Permanent wet" increase the responsibility of the department and leads to unnecessary waste. The following improvements are proposed to make the channel work to a high duty :—

*Proposed improvements.*—(1) To remove obstructions in the channel and to correct awkward bends by straightening them.

(2) To regrade the channel and to silt it up to proper shape in places where it is too broad.

(3) To provide sluices for all the minor channels branching from it and fit them with screw-geared shutters.

(4) To do away with the day and a half turn at the Sithamalli calingula and to supply the Sithamalli channel instead from the Vallam channel which takes off from below the Kondappan-Cauvery aqueducts, by extending and improving it. This will give sufficient command, but will necessitate the diversion of the South Rajan Vaikal for half a mile where it flows along the toe of the Coleroon flood bank and actually eats into it. This is likely to cost about Rs. 5,000 which can by no means be viewed a high price when the interest of 15,000 acres of lands below is considered, and also the safety of the flood bank when the river runs at its maximum. The existing channel may be allowed to remain as it is now, but without the benefit of the turns, if the high level fields that cannot be irrigated otherwise, do not exceed 30 acres.

(5) To do away with the turn at the Vadarangam calingula and instead to build a regulator at mileage 15·675 of the South Rajan Vaikal to divide water between the main channel and Oosi Vaikal which irrigates 2,480 acres, and to dig a channel about 2 miles below along the right bank of South Rajan Vaikal to command about 4,000 acres, irrigated at present by several channels taken off from above the Vadarangam calingula. This will do away with internal turns, and facilitate economic usage of water.

(6) To construct a regulator near Achalpuram where the South Rajan Vaikal divides into four.

(7) To raise the banks of the South Rajan Vaikal to facilitate their frequent inspection.

(8) To rebuild the Narimudukku and Kondappan-Cauvery aqueducts with greater water-way to facilitate the free flow of drainage during heavy rains, the heading up of water above being as much as 3 feet as observed this year. These improvements are not so very pressing but should not at the same time be lost sight of when the improvement of the drainage system of the delta is taken up.

*Proposals to supplement Pudumanniar from South Rajan system.*—It was the intention of Mr. Lobb to so improve the South Rajan Vaikal as to carry enough supply for its ayacut (17,027 acres) and to supplement the Pudumanniar. This extra supply he would divert into the latter above the Mukkutu regulator through the Oosi Vaikal, a branch of the South Rajan Vaikal. He calculated that a supply of 2 cubic yards per hour per acre (66⅔ duty) is sufficient for lands under the South Rajan and half that quantity for lands under the Pudumanniar. At this rate the supply in the Oosi Vaikal should be increased from 150 cusecs to 230 cusecs while the entry at the head should be reduced from 550 cusecs to 448 cusecs as contemplated by him. This supply would have to be increased to at least 680 cusecs at the commencement of the irrigation season when the demand from lands under the Pudumanniar would be as high as those under the South Rajan Vaikal. The disadvantage of shaping a channel to carry such widely varying supply from 255 to 680 cusecs is obvious. Mr. Lobb proposed the widening of the channel and this would, to a great extent, neutralise its efficiency in irrigating lands dependent on it, when the supply at the head is just sufficient for or even less than the legitimate demand of the existing ayacut. Colonel Smart advocated instead the advisability of running the channel to an increased depth amounting to as much as

8·5 feet; but this would induce too high a velocity amounting to as much as 3 feet per second in the channel and would erode its bed badly. Considering all these facts, I am inclined to view the proposal of having a separate channel from the Lower Anicut with a separate head sluice more favourably. This would run to the right of the Kumukkumanniar and carry all the supply necessary for supplementing the Palavar and Pudumanniar as it becomes available and would drop into the Manniar immediately above the junction of the latter with the Kumukkumanniar. This arrangement will render the improving of both the South Rajan Voikal and the Kumukkumanniar contemplated previously, unnecessary and will at the same time not complicate regulation in the least.

(c) *South Arcot side—The North Rajan Voikal.*—This channel takes off from the left side of the northern branch of the Coleroon above the Lower Anicut and irrigates about 18,856 acres situated in the South Arcot district. It is 28 miles 3 furlongs long; runs parallel to the Coleroon for the greater portion of its length; and is in good condition except for 9 miles from its head. It is not of uniform width, too broad in many places, and flows 6 feet deep when it runs its full supply, when it carries 715 cusecs representing a duty of only 27 as against 66, the figure that Mr. Lobb and Colonel Smart intended to work it to without any internal improvement. It has six calingulas constructed across it to raise water to lands commanded by them by turns. The first of these known as Omampuliyar calingula is at 9 miles 1,420 feet and is closed for two days in a week to irrigate lands dependent on it, which is said to be impossible unless the channel runs 6 feet deep. The next, the Puliangudi calingula, is at 15 miles 1,900 feet and is closed for two days in the week; the high level lands under this are said to be commanded only with 3 feet gauge on its crest, which it is not possible to maintain unless the channel runs its full supply. The third called the Kopadi calingula is at 20 miles 1,055 feet just above the old Coleroon aqueduct and has a two days' turn; the fourth, the Vyur calingula, at 21 miles 4,880 feet a 30 hours' turn under certain restrictions. The other two calingulas known as Elavangore and Sivapuri (in ruins) have no turns unless the channel runs very low. From the North Rajan Voikal many branches are taken and these generally have sluices built at their heads capable of being regulated while a few that have not are being provided with them. It intercepts a few drainage courses and many of these being insignificant are admitted into the channel; the largest and most important of these is "the old Coleroon" through which the surplus of the Veeranam tank is diverted into the Coleroon (main river). It is crossed by a masonry aqueduct consisting of 9 bays of 28 feet span and 6 feet rise with piers four and a half feet high between. There is also a second aqueduct to cross the Gavarapet channel, a branch of the Khan Sahib's canal, irrigating about 3,000 acres of lands situated near the sea, beyond the influence of the North Rajan Voikal. Both the above aqueducts are made to carry the Chidambaram-Mannárgudi road.

During his investigation of the Lower Coleroon Anicut system, Mr. Lobb assumed that the North Rajan Voikal was in a fit condition to be worked to a duty of 66, and that the clearing of silt, which was then in progress would, when completed, do all that need be done for the channel. Colonel Smart, when reviewing his proposals, admitted his statement evidently without enquiring into the fitness of the channel. It is as mentioned before too broad for the irrigation under it and when it runs full supply, discharges two and a half times as much as is required; anything less than this interfering seriously with the command of high lands. It is therefore proposed to improve the channel as noted below and regrade it after bringing it to proper shape, so as to enable it to irrigate the lands under it without having recourse to turns, when worked to a duty of 66 cusecs.

*Proposed improvements.*—(1) To improve and shape the channel to the required width and raise the banks on both sides of it to proper level.

(2) To straighten the few awkward bends that still remain to be done.

(3) To provide the remaining branches of the channel with sluice at their heads.

(4) To shift the heads of the high level branches wherever necessary above their present position so as to command the lands under them without any difficulty.

(5) To do away with the two days' turn at the Omampuliyur calingula by shifting the existing heads of channels 3 — 4 miles higher up to give sufficient command to lands under them or to supply these from a new channel proposed for lands now irrigated by the Vadavar direct (*vide* paragraph 2, page 44).

(6) to shift the heads of the three or four channels irrigating a small extent of high lands above the Puliangudi calingula sufficiently higher up and to do away with the two days' turn now observed.

(7) To do the same to Copadi and the Vyur calingulas.

(8) To improve the minor distributaries when wastage is found to exist by re-aligning them.

(d) *The Vadavar.*—This takes off from the left flank of the northern branch of the Coleroon at the Lower Anicut, like the North Rajan Voikal and is the main source of supply to the Veeranam tank. It has considerably less fall than the North Rajan Voikal and is taken along a contour falling at the rate of about 6 inches per mile for nearly 14 miles and directly

irrigates 10,603 acres situated to the right of it. It has a bottom width of 100 feet decreasing to 60 feet within a mile of the head and flows 8 feet deep while running full, discharging in its present silted condition 880 cusecs. It has no sluice at its head to regulate supply into it and thus during periods when the Coleroon is in flood and the tank is full a large volume of water enters the latter unchecked and floods the Chidambaram taluk causing considerably more damage by prolonging the period of submersion than it would be otherwise. Near its head there is a bridge carrying the Madras-Kumbakónam road consisting of three arches, the centre one being of 60 feet span and the side ones 20 feet each. Two upland drainages enter the channel, one, half a mile below its head, known as "Sengal odai" draining 38 square miles, and the other, 4½ miles lower down under the name of "Karungal or Karuvattu odai" draining 29 square miles. The former is said to account for the greater portion of the sanding of the Vadavar near its head, the silting this year being as much as 5 feet. From the Vadavar several branches are taken to irrigate the 10,603 acres under it, and all of these have been provided recently with sluices regulated by screw-geared shutters. A bridge of 3 arches of 30 feet span carries a road to Nattarmangalam across the Vadavar a mile above its infall into the Veeranam tank. The Vadavar from the beginning has not been in an efficient state and there have always been complaints about its defective supply and heavy silting, which was attributed to the effect of the solid anicut across the Coleroon and about the washing in of silt by the Sengal odai entering the Vadavar below its head. Mr. Lobb in his report in 1886 proposed the diversion of the odai into the Coleroon above the Lower Anicut and the conversion of the existing bridge into a head sluice, to minimise the existing defects and to regulate the supply to the Veeranam tank. He would also give an increased fall of 9 inches per mile to the channel. His proposals then attracted the attention of Engineers of the South Arcot district and various improvements have from time to time been suggested to better the Vadavar. A separate channel to fill the Veeranam tank was proposed with its head higher up the river, the advantage claimed for this being—

*Various proposals for improvements at Vadavar head.*—(*a*) That the head could be chosen where little or no heavy silt could enter, (*b*) that the Sengal odai could be easily disposed of either under or over the Vadavar and (*c*) that there would be no interference or tampering with the present arrangements for supplying direct irrigation under the Vadavar. This was enquired into by the Special party in 1904, and was given up as not practicable on account of its heavy cost, and other inherent defects in the scheme itself. Another proposal was advanced to construct a regulator at the first mile of the Vadavar and a surplus sluice worked by screw shutters a little above it with a channel running into the Coleroon, the admission of water to the North Rajan Voikal being regulated by a similar sluice built across each. A third proposal was to shift the position of the regulators still further down to 4½ miles from its head where the Karungal odai enters it. A fourth advocated the construction of a groyne or a training wall across the head of the Vadavar, the lowering of the cills of the first three bays of the anicut by 5 feet, *i.e.*, to 3 feet below the cill of Vadavar head sluice and to cut back the nose or spit of ground between the Vadavar and the North Rajan Voikal to enable top water being drawn off during floods. A fifth was to build a training wall from the right end of the last of the three bays lowered as described above. A sixth recommended before there was any idea of cutting down the solid anicut and substituting moveable lift shutters, the building of new head sluice for both the Vadavar and the North Rajan Voikal in front of the north wing of the Rajan head sluice and nearly at right angles to the general direction of the anicut, and to make use of the existing head sluice as a scouring sluice into the Coleroon. A seventh consisted of the fitting in of huge lift shutters and the construction of escapes into the Coleroon one mile below the flood water being prevented from passing down the North Rajan Voikal by converting the old dismantled lock in it into a regulator. An eighth proposal was to have a groyne more than two furlongs long, starting from above the existing head of the Vadavar in the direction of the northern end of the anicut after cutting down the existing anicut by another two feet and making it up by substituting shutters 8 feet high instead of the existing 6 feet ones, and diverting the Sengal odai into the Coleroon above the anicut the intention being to keep the Vadavar free from silt by drawing the supply to it round the existing nose or spit between it and the North Rajan and by inserting shutters 3 feet high in the road bridge. This proposal has been approved and sanctioned for execution in G.O., No. 944 I., dated 1st September 1906.

Sanctioned.

Discussion of objections to sanctioned scheme.

The heavy silt in the channel prior to the lowering of the anicut was attributed to the existence of the latter and perfect immunity from it was claimed for the channel afterwards. But the experience of the past five years has proved otherwise. There is still 5 feet of silt and greater prominence is now given to the Sengal odai as a cause. Whether the improvements recently approved will answer expectations seems to be problematical. The supply into the Vadavar in its present state is practically drawn off 5 feet above its cill or at a level 3 feet above the crest of the existing anicut. An ideal state can therefore be obtained only when the existing crest is lowered by 5 feet and shutters 11 feet high are substituted in the two branches instead of the 8 feet ones recently sanctioned. But considering the heavy outlay involved by such a scheme, I beg to suggest for consideration whether the object cannot be attained by constructing a head sluice for the Vadavar and the North Rajan Voikal close to the

Suggested modifications.

margin of the river at right angles to the Anicut from its northern wing, and substituting 11 feet shutters for the end 8 vents, with a training wall. This will induce a draw in front of the head sluice and keep it clear of sand; while arrangements to draw off top water by fitting shutters after Brockman's pattern to the head sluice would effectively prevent the rolling in of sand. This arrangement would give the additional advantage of minimising the surplus of the Veeranam tank by completely stopping the supply from the head of the Vadavar when not required and thereby save the lands below from damage due to submersion. This would involve also the fitting in of an equal number of vents on the right flank of the southern branch with high shutters to equalise the strain on the two branches during floods.

38. Under the proposal recently sanctioned for execution, the Vadavar will be widened to 100 feet bottom width throughout its length. The result of this would be, when the river is low, to affect the supply to sluices in the channel, by decreasing the depth which it would otherwise maintain. But it is affirmed in page 12, paragraph 5 of the same report (G.O., No. 944 I., dated 1st September 1906), that the supply to the sluices would not be appreciably affected since the cills of almost all these, and also the existing bed of the main channel are below the proposed bed. These arguments seem hardly conclusive. It is a notorious fact that in the Cauvery delta the cills of nearly all the sluices are too low and that the beds of channels in rear are nearly 3 feet and 4 feet above them. Any inference therefore about the full supply depths in channels, without reference to levels of fields below them cannot be considered safe. Again the Vadavar, being essentially a tank-filling channel with no masonry works to keep its bed level constant, would naturally be expected to be cut back in its lower reaches, as is now the case on account of the greater surface-fall available when the tank is either partially full or empty. The expectation therefore of seeing the channel silt up to the proposed bed level after the improvements are done cannot be realised; any extra supply thrown into it on the other hand would tend to lower its bed level still further and the natural effects of the above two measures therefore would be to starve the direct irrigation under the Vadavar during periods of low supply. However their practical effects may be observed for a few years, if considered necessary, and the improvements sketched below executed. It is my object to keep the Vadavar essentially a tank-filling channel and to take up the existing irrigation of 10,603 acres under it and the 4,405 acres in the first reach of the North Rajan Voikal above the Omampuliyur Calingula, under a new channel with a new head sluice built at the lower anicut between the Vadavar and the North Rajan. The existing channels can be used as much as possible (see tracing enclosed marked Z showing the Vadavar irrigation). This proposal will tend to economise water and place the Vadavar irrigation on a better footing. During periods of low supply full advantage of the storage in the Veeranam tank can be taken by shutting out of the Vadavar all the supply and distributing the available water equitably and to the best advantage between the new and the existing channels. The cost of the proposal may stand at the outset against its acceptance, but the advantage gained by it seems to me to far outweigh the initial cost. The drainage of lands between the Vadavar and the North Rajan Voikal, in its first reach will also be considerably improved. The existing objectionable system of taking the irrigation channels across the drains by means of syphons having too little water way can be done away with entirely.

*Further improvements suggested.*

39. From his Table of supply available in the Coleroon during years 1865—1885 at the Lower Anicut, Mr. Lobb found it necessary to increase the storage in the Veeranam tank by raising its F.T.L. 2 feet to enable the Coleroon to spare water to supplement the Palavar or the Pudumanniar at a very high duty of 1 cubic yard per hour per acre or $133\frac{1}{3}$ acres per cusec. He fixed the supply necessary for the South Arcot side at 930 cusecs, calculated with a duty of $66\frac{2}{3}$. This, Colonel Smart in his report on Lower Coleroon Project printed with G.O., No. 523 I., dated 8th May 1902, considered too high and proposed its reduction to 675 cusecs taking into consideration the effect of storage in the Veeranam tank as it is at present. But it does not seem to be based on sufficient data to render it safe to be adopted for guidance in all years. The proposal to raise the storage of the Veeranam tank by 2 feet has recently been approved for execution and the scope of the project extended to 34,000 acres, now under the Shatiatope anicut system. Here also the data on which the supply available in the Coleroon has been estimated are not convincing, since the records of only 3 years (1901—1903) have been considered and the tank failed in one of these. In these circumstances it becomes most essential to improve the internal distribution so as to make the best use of water available.

40. About 52,397 acres on the South Arcot side depend either directly or indirectly on the Veeranam tank, to which the Vadavar forms the main source of supply; of these 39,451 acres are irrigated by about a dozen channels taking off from sluices built in the tank bund. These channels have not been gauged as the supply into them is made to depend more on the state of the tank than on demand. Anyhow, wastage must exist in these two as they cannot be said to be in any way in better condition than the North Rajan Voikal and is distributaries.

41. The balance 12,946 acres depend on the drainage from the land irrigated by the Vadavar direct, the Veeranam tank and a portion of the North Rajan Voikal; of these 2,880 acres depend on Pasimuthan Odai, a channel draining the area bounded by the Veeranam tank on the west, the Buthangudi channel on the north, the Chandran channel on the south and Ponneri tank on the east. It had no direct source of supply until recently when the Paruppa-

nathan channel was extended to supplement it from Veeranam tank and found necessary. It is nearly 16 miles long down to its outfall into the Vellar and takes into it the surplus of the Ponneri tank in its 8th mile. Lower down its course it is practically an irrigation channel carried on side-long ground sloping gradually towards the east, the land to the right of it draining into the Khan Sahib's canal, and that to the left into Buthangudi or Sivagami-amman drain running parallel to the Pasimuthan Odai close to it but on a lower level and joining the Odai in its 12th mile below Regulator No. 2 across it. Near Chidambaram it has a weir (Tillaiamman surplus) over which its surplus is run into the Khan Sahib's canal. It has two calingulahs across it within a mile and a half from which water is raised for irrigating lands to its right and these have recently been converted into regulators fitted with shutters of iron. During rains the Odai gets considerably congested and the land draining into it gets water-logged; the existence of the two regulators mentioned above considerably interfering with its carrying capacity. Virtually a portion of the surplus is received into the Khan Sahib's canal, which will also be more than full then, much to the damage of lands draining into it. It therefore would seem advisable to make the drain capable of carrying the surplus running into it by doing away with the two regulators mentioned above and in their stead fitting the road bridge just below the Thillaiamman surplus with lift shutter and excavating a side channel to irrigate the land under them. Its existing left bank below the bridge can then be removed and its width increased by including the Buthangudi drain in it; the existing regulators may also be demolished to give a greater fall to the drain, and a straight cut to the Vellar about 2,000 feet long excavated in the limits of Kilamanguladi village. The shutters removed from the regulators can be utilised on other works to be proposed for the Khan Sahib's canal.

Proposed improvements to Vadavar drainage.

42. Another channel draining the land between the Vadavar and the Veeranam tank and the North Rajan Voikal and Pasimuthan Odai irrigates 10,066 acres below Chidambaram town. It receives in addition the surplus of the Veeranam tank from the Lalput weirs. During the rainy season, when the tank surpluses it flows overfull. A regulator has recently been constructed across the Khan Sahib's canal below Komaratchi with the object of diverting the surplus into the old Coleroon over two weirs (Copadi weirs) constructed in its right bank, of admitting into it 3,600 cusecs when the surplus exceeds 11,500 cusecs and of relieving the land below from submersion as far as possible. Below this the channel receives the drainage of nearly 47 square miles and has no irrigation till it reaches Chidambaram. Here a surplus known as Muthiya Pillai surplus recently fitted with shutters discharges the excess into the Uppanar a natural drain. Within the town its drainage and the surplus of Pasimuthan Odai enters the channel and a mile below another surplus (Thiruvakulam surplus), recently fitted with lift shutters, disposes of the excessive supply into the Uppanar. From this point the irrigation of the Khan Sahib's canal practically begins. The channel below receives very little drainage, the little that gets into it being discharged over a vented weir near Killai on its left; it tails into the Vellar where exists a regulator to hold up water in the channel. In spite of the improvements hitherto effected, the Khan Sahib's canal gets congested during rains and does not act satisfactorily. Lands draining into it suffer heavy damage from prolonged submersion. It would seem advantageous to minimise this loss as far as possible by improving (1) the old Coleroon which is now 100 feet broad to its full width of 160 feet (originally proposed by Mr. Davidson) and increasing its carrying capacity. This drain this year flowed 14 feet deep and discharged 11,500 cusecs when the Coleroon was low and the proposed widening would therefore considerably improve its discharging capacity much to the advantage of the land above the Komaratchi bridge whose submersion has, after the construction of the regulator, become more frequent and prolonged. This would necessitate the improving of the water-way of the existing aqueducts of the North Rajan Voikal which can easily be done by providing one of these with a ferro concrete or iron trough after demolishing the existing masonry arches which obstruct the waterway when the drains run overfull; (2) by improving the carrying capacity of the Khan Sahib's canal below the regulator as far as Thiruvakulam surplus; (3) by increasing the waterway of the Muthiya Pillai and Thiruvakolam surplus-sluices considerably; (4) by constructing a regulator across the Khan Sahib's canal below the Thiruvakulam surplus to prevent the drainage from entering the channel below and submerging it; (5) by improving the Uppanar which relieves the Khan Sahib's canal considerably, by widening and straightening it and (6) by excavating a straight cut 1,000 feet long to connect the Uppanar with a back-water which is said to have always an open bar between Pishavaram and Kilaparamba villages.

Proposed improvements to Khan Sahib's canal drainage.

43. *Proposed improvements to Khan Sahib's canal irrigation.*—In the estimate sanctioned recently for connecting the Vellar with the Coleroon, it is proposed to raise the irrigation under the Khan Sahib's canal from second-class to first-class source. This channel has no direct source of supply and any improvement therefore either to the Vadavar or to Veeranam tank cannot be said to benefit it, unless means are provided to give it a direct source of supply. At present a small vent in the Puliangudi aqueduct of the North Rajan Voikal introduced some two years back supplements the Khan Sahib's canal in a way. It therefore becomes necessary to give it a direct supply either from the Veeranam tank by opening a vent in one of its weirs near Lalput or

to make the North Rajan Voikal spare enough water after relieving it of the irrigation of lands in its first reach, as proposed in paragraph 38 when dealing with the improvement of supply to lands directly depended on it. The latter course may render the construction of regulators across the North Rajan Voikal a mile above the Puliangudi calingula necessary in order to regulate the supply between it and the Khan Sahib's canal.

44. *Further proposals for improvement of supply to Palavar.*—The measures proposed above in connection with the Kumukkumanniar, the South and North Rajan Voikals, the Vadavar with the channels under the Veeranam tank, the Pasimuthan Odai and Khan Sahib's canal are expected to improve these considerably and render them fit to work to a duty even higher than 66; while the wastage that exists at present, can be utilised in supplementing the Palavar or the Pudumanniar. It has been said before, that the best way of diverting the supply made available into the Palavar is, by excavating a new channel 8 miles long parallel to the Kumikku-manniar and to the right of it, to be dropped into the Manniar a few miles above its junction with the Palavar. To ensure the proper and economical distribution of this supply the Palavar and the distributaries from it have also to be improved. It is therefore proposed to improve the Palavar and its continuation the Pudumanniar, by raising the right bank from its junction with the Manniar, and to correct the awkward bends in it; (2) to improve the Gopalasamudram Regulator, which acts prejudicially, to the interests of lands below, and to shift the head of high level channels benefited by it, 2 or 3 miles higher up, to ensure an easy command; (3) to remove the Mukkuttu Regulator which obstructs the water-way and instead to fit the central vent of the aqueduct adjoining it with a shutter to regulate effectively the supply into the Kali-malaiyar branching from above it and into the Pudumanniar; (4) to improve the Govinda Cauvery by regrading it carefully so as to command the lands under it; (5) to rebuild the sluices below the Gopalasamudram regulator and fit them with screw-geared shutters; (6) to widen the Pudumanniar below the Kittianai surplus; (7) to improve the irrigation of Thandavankulam lands by giving them a separate channel taking off sufficiently high up the Pudumanniar so as to ensure an easy command; (8) to widen and straighten the Uppanar which originates at the Uppan dam, to enable it to take extra water that will be thrown into it, without submerging the lands on both sides of it; (9) to improve the minor drains and the tail-end of the Cauvery so as to relieve the lands between the latter and the Uppanar, as proposed by Col. Smart; (10) to improve the Vettangudi-Vadigal, by giving it a proper outlet into the sea and widening it considerably; (11) to disconnect the Kittianai Uppanar from the Coleroon by closing the existing branch below Pudupatnam and diverting the Kittianai Uppanar into the sea near the mouth of the Coleroon to the south of Devikotta, and thus to restore its former efficiency; (12) to irrigate the bit of land 120 acres in extent that will be cut off by the proposed diversion either by a channel from South Rajan Voikal along the proposed flood bank or from the Pudumanniar by a pipe syphon; and (13) to extend the existing right flood bank, from Mahendrapalli to the sea along the present course of the river to the south of Devikotta in order to protect the Pudupatnam and Thandavankulam lands.

45. The last three proposals will give all the necessary protection to the tail-end lands that now complain bitterly of frequent submersion when the Coleroon is in flood and of want of efficient drainage, and will render unnecessary the existing proposal of banking the Kittianai Uppanar on both sides for $6\frac{1}{2}$ miles and the construction of many drainage sluices in them to exclude the Coleroon floods at a cost of nearly a lakh.

46. *Discussion of the Cauvery-Vennar Morai.*—The Superintending Engineer, V Circle, in his No. 333 E.I., dated 21st July 1906, has expressed an opinion that some alteration in the Cauvery-Vennar Morai would favourably affect the supply into the Palavar during periods of low supply in the Cauvery. The existing rules in force require the closing of each of the regulators at the heads of the Cauvery and the Vennar alternatively for 2 days in the week the water available at the head happens to be less than full supply and to force it down the other and to apportion the supply during the remaining 3 days between them according to their ayacuts. This arrangement he objects to on the grounds that during the 3 days of proportionate supply all available water gets wasted in the first reach and the tail-end lands are practically made to depend on the remaining 2 days' turn. He suggests instead, the advisability of extending the period of full supply to each of the rivers to $3\frac{1}{2}$ days. But the existing rules have this advantage, a very material one, that each of the branches runs for 5 days in the week and would thus give greater time for irrigating the large extent under it, the 2 days of full supply being utilised to irrigate high level lands at the head of the delta. With proper regulation it should therefore be of greater advantage to stick to the existing system the periods of proportionate supply being utilised to give full supply to channels in the lower reaches by turns, after closing the sluices in the upper reaches.

47. The proposed change further implies in a way the inability to control the wastage at the head, and so long as this is allowed to stand, any change in the Morai cannot be said to appreciably improve the supply to tail-end lands. Further, the object of increasing the supply to the Palavar can be better accomplished by sticking to the existing rules of regulation at the head and by creating a direct source of supply to it from the Cauvery, than by any change in them to facilitate forcing more water down to tail-end lands with the distant expectation of receiving a small portion of this into the Palavar as drainage. It would be possible to say

much in favour of both; but I would prefer, before ordering an investigation, to wait till the remodelling of the delta is completed, and an Irrigation Cess Act is passed when, in all probability, the necessity of such an enquiry would not exist at all.

48. *Discussion of supply to Palavar resumed (through Manniar).*—There is yet another source by means of which the supply to Palavar might be improved. The Manniar, which is at present fed by the Coleroon through a head sluice 27 miles above the Lower Anicut, has ceased to draw an adequate supply from the river and the irrigation under it is very badly off. The set in the Coleroon from which the channel takes off has deserted it and its head has silted up in consequence. It is under contemplation, therefore, to shift it about 3 miles higher up the Coleroon to a set which is expected to be permanent and to extend the Manniar to it at a cost of more than Rs. 70,000. I would suggest for consideration the advisability of supplying the Manniar from the Cauvery instead, preferably from near the Vaduvagudi surplus. This will increase the length of the channel by another 4 miles the cost of which cannot amount to more than half of what would be necessary for the head sluice proposed; and will at the same time ensure a better supply to lands under it and will supplement Palavar too in a way. After completing the improvements now proposed for the Palavar or Pudumanniar, it should be found possible to transfer the lands under it from 2nd class to 1st class, as is proposed to be done for lands under the Khan Sahib's canal of the Lower Coleroon anicut system, after the improvements for the Veeranam tank now in progress are completed. This will give a net increase of not less than Rs. 27,000 a year in revenue.

49. *The prior claims of the Vadavar.*—The defective supply in the Vadavar from the very beginning, on account of heavy silting up of its head, has been often complained of. With water to the crest of the anicut (prior to the fixing of shutters) it was said by Mr. Lobb in 1886 to receive only about a third of its full supply (310 cusecs) and the full supply of 930 cusecs to be not available before water surplused 2·56 feet over the anicut (or 0·50 feet above the top of existing shutters), which limited the period of full channel to fifteen days in the year on an average. Gaugings of velocity taken this year for different depths in the channel would show that the lowering of the crest of the anicut by 4 feet and the substitution of shutters 6 feet high have not materially improved matters. The channel has discharged when flowing 6 feet deep (crest of the old anicut) only 265 cusecs, and with 8·5 feet depth 1,024 cusecs. During periods of low supply the Vadavar has thus failed to receive any supply unless water rose to over 3 feet from the top of the shutters. This channel has 63,000 acres under it, of which 10,603 acres are irrigated direct and the balance from the Veeranam tank, to which this forms the principal feeder. The tank does not hold more than a fortnight's supply (calculated at 66 duty) for the extent dependent on it. The North and South Rajan Voikals and the Kumukkumanniar, which together do not irrigate more than 60 per cent. of the extent under the Vadavar, draw into them all the available supply when the river is low, as they have their cills at not less than 10 feet below the top of shutters, and are practically free from any such disadvantage. In these circumstances, it was considered necessary in 1896 in the interest of the Vadavar whose superior claims should be allowed when its existence long before the other channels were dug is recognised, to frame certain rules to give a sort of supply to it, by which (1) the North Rajan Voikal is closed for two days in the week, when the water in the river with all shutter closed falls to 2 feet below the top of the shutters (crest of the old anicut), and both the Rajan Voikals are closed when the level falls to 3 feet or more below, in either case care being taken not to allow the water to surplus over the shutters. There have been since then constant complaints from the ryots under the other channels protesting against the morai though in justice it should be admitted that the Vadavar has not even now been fairly dealt with, when its silted state and the large extent of land dependent on it are considered. I would therefore suggest that the present "morai" be continued till the Rajan Voikals are improved to work to a duty of 66, the Vadavar sluiced at its head, the channel improved and the land directly dependent on it provided with an independent source, as proposed in paragraph 37, the extent under the Shatiatope anicut system amounting to 34,000 acres, to which it is proposed to give the benefit of the Coleroon water, being denied any participation therein. The supply, it is proposed to draw for supplementing the Palavar or the Pudumanniar, can be wholly met from the water spared by stopping the wastage in the Rajan Voikal as shown below :—

| Name of channel. | Ayacut. | Full supply at 66. | Existing full supply. | Remarks. |
|---|---|---|---|---|
| | ACS. | CUSECS. | CUSECS. | |
| South Rajan Voikal .. .. .. | 17,027 | 258 | 145 | |
| North Rajan Voikal .. .. .. | 18,856 | 286 | 715 | |
| Kumukkumanniar .. .. .. | 1,280 | 20 | 130 | |
| Palavar .. .. .. .. | 87,681 | 571 | .. | |
| Vadavar .. .. .. .. | 63,000 | 955 | 880 | When water is to top of shutters—*vide* G.O., No. 944 I., dated 1st September 1906. |
| | 87,000 | 1,467 | .. | |
| | .. | 2,090 | 2,170 | |

*Internal state of whole delta discussed.*—I have tried to show that the improvement of water-supply to Shiyáli taluk is more intimately connected with the remodelling of the delta as a whole than is generally admitted. This system, though it forms the largest and most profitable inheritance in the Presidency, cannot be said to have received sufficient attention from the Engineers. Improvements done to it till now have only been confined to establishing sufficient control over supply entering the delta at its head The main and minor distributaries in the delta have been much neglected and repairs, etc., done to them annually have hardly been sufficient to maintain them in their original condition, the annual expenditure being at the rate of 1 anna 7 pies per acre, while the Gódávari and Kistna deltas spend 5 annas 8 pies and 8 annas 3 pies per acre (*vide* enclosure S " Comparative statement showing the grants under 'Extension and Improvements' and 'Repairs' for the Gódávari, Kistna and Cauvery Deltas"). The distribution of water among the distributaries, etc., except at the heads of main rivers, is entirely in the hands of the villagers which entails great wastage of water in the higher reaches and deprives lands at the tail-end of the delta of adequate supply even when the rivers carry considerably more than full supply at their heads. The absence of an irrigation cess law renders any real improvement impossible without running counter to some vested rights in the distribution of water, which the Civil Courts must uphold when taken before them, as is generally done. The practice of indiscriminately allowing dry lands on high levels to be converted into wet by the Revenue authorities, without consulting the Public Works Department about the feasibility of irrigating them, increases its responsibility and leads to unnecessary wastage much to the detriment of lands in the lower reaches. The average duty attained is considerably lower than what it ought to be when the delta is remodelled on account of the large wastage that occurs. The construction of a reservoir across the Cauvery now contemplated will, in the present state of the delta, lead to greater wastage. By supplementing as it should the deficient supply in the Cauvery during November, December and January with an economical distribution in the delta among distributaries properly graded and improved, it should, on the other hand, aid in supplying a considerably larger extent elsewhere under the proposed Pattukkottai project, by setting free the supply that would otherwise get wasted. In the delta of the Gódávari where the main canals which carry a steady supply throughout the irrigation season work to a duty of over 100, it is considered profitable to invest large sums of money in regrading the channels which may be said to be in an ideal condition when compared with the channels here. Therefore any capital invested in such improvements to the Cauvery delta along with drainage improvements should prove more than remunerative. This work it is not possible to do systematically by the ordinary divisions which have the onerous duty of looking after the regulation of water in the delta and ordinary repair work. I would, therefore, suggest the formation of a special division to estimate for improving the delta according to a programme prepared previously in consultation with the Executive Engineers of the Cauvery and Vennar Divisions and approved by the Superintending Engineer. The grant under "Repair" should be increased to 5 lakhs, half of which the Special Division should spend in improving the main distributaries and drains, leaving the minors to be done by the ordinary divisions. I advocate this system as best suited for the Cauvery delta which is most complicated, though it may seem to aim at too much centralisation; improvements proposed by Special Division would in the ordinary course go to the Executive Engineers of the Cauvery and Vennar Divisions for opinion and thus have the benefit of their local experience before assuming a final shape. Minor improvements necessary for bettering the supply to Shiyáli taluk have been dealt with in the body of the report and these need not wait for the general improvements of the delta as a whole, and can profitably take even then a first place in the list.

V. T. SRINIVASA AIYANGAR,
*Special Sub-Divisional Officer.*

28*th March* 1907.

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## IV

### No. 2348, dated 17th June 1907.

In returning the papers received with his No. 157 E.I., dated 1st May 1907, the Acting Chief Engineer for Irrigation has the honour to point out that all the tables drawn up by the Sub-Engineer on special duty are based on an assumed duty of 44 and 66 for the Cauvery and Vennar respectively at the Grand anicut and that statement A depends on this assumption. These duties are not attained at present and in the opinion of the undersigned cannot be attained under existing conditions.

2. The actual figures of crop under cultivation each month in the System are not available, but by using the last season reports and assuming that all the wet cultivation in Tanjore is in the Cauvery system, a rough approximation may be made, the error which exists giving a higher duty than is actually the case. It has also been assumed that first crop is on the ground for 5 and second 3 months. The years 1900–1901 to 1904–1905 have been taken and the corresponding discharges have

been taken from statement W. From these assumptions the following duties are deduced :—

| Months. | | Area under cultivation. | Total. | Average supply. | Duty. |
|---|---|---|---|---|---|
| 1 | | 2 | 3 | 4 | 5 |
| | | ACS. | ACS. | | |
| July | 1st | 38,558 | 38,663 | 22,380 | 1·7 |
| | 2nd | 105 | | | |
| August | 1st | 170,086 | 170,363 | 21,394 | 7·9 |
| | 2nd | 277 | | | |
| September | 1st | 442,851 | 443,465 | 14,802 | 29 |
| | 2nd | 614 | | | |
| October | 1st | 694,272 | 717,451 | 14,156 | 50 |
| | 2nd | 23,179 | | | |
| November | 1st | 758,742 | 816,030 | 6,989 | 117 |
| | 2nd | 57,288 | | | |
| December | 1st | 731,763 | 791,514 | 4,971 | 160 |
| | 2nd | 59,751 | | | |
| January | 1st | 601,756 | 639,830 | 2,389 | 267 |
| | 2nd | 38,072 | | | |

Remarks.—Column 4 is average supply for years 1900–1901 to 1904–1905 table from statement W.

3. These duties show that unless existing conditions of the Cauvery delta are altered it is impossible to think of giving an early supply to the Palavar *viâ* the Lower Anicut. The Sub-Engineer has assumed a constant discharge of 14,973 cusecs into delta at Cauvery-Vennar Regulator but in July and August it is actually about 22,000 cusecs. It is evident that enormous quantities of water are passed through the delta without being used early in the season and the Superintending Engineer is requested to report what becomes of the unutilized supply during July, August and September.

4. Turning to the actual proposals made by the Sub-Engineer, in the first place it is requested that maps drawn to a suitable scale may be submitted showing clearly the position of each of the works which it is proposed to construct, alter or abolish.

5. On page 16 of the report when dealing with the S. Rajan voikal it is proposed to do away with the Sidhamalli calingulah and to supply the existing channel from the Vallam channel. It is not clear what advantage would be obtained by this especially if it is proposed to retain the existing head without the dam. This proposal should be more clearly explained.

6. On page 44 of the report when discussing the proposal to construct a head sluice to the Vadavar, it is stated that the supply down it into Veeranam tank tends to increase the floods in Chidambaram taluk by prolonging the period of submersion. The undersigned is under the impression that when there are severe floods in Chidambaram taluk the level in the Coleroon at the lower anicut is not high enough to give any large discharge down the Vadavar. Figures should be adduced in favour of the statement made by the Sub-Engineer.

H. E. Clerk,
*Ag. Chief Engineer for Irrigation.*

To the Superintending Engineer, V Circle.

## V

*Letter*—from S. D. Pears, Esq., Superintending Engineer, V Circle.
*To*—the Chief Engineer for Irrigation.
*Dated*—the 3rd January 1908.
*No.*—6 E.I.

With reference to your Memorandum No. 2348, dated 17th June 1907, I have the honour to enclose, in original, letter No. 9356, dated 11th December 1907, from the Executive Engineer, Cauvery division, with its enclosures.

2. Speaking with little local knowledge and therefore with much diffidence, I still mistrust the proposal of the new channel from the Lower Anicut to supplement the Palavar, as being wrong in principle. As already stated in my letter No. 157 E.I., dated 1st May 1907, the Lower Anicut can certainly spare no water for the maturing of the cultivation (January, February and March) and it seems to me still unproved that there is water to spare even in July, August, September and October. To make the channel and then to find that there is no water to spare, which would certainly be the case in bad years and might even be the case in average ones (so untrustworthy are our present data), would be to immensely complicate the Lower Anicut distribution arrangements; and in proportion as the proposed channel was useful for irrigation it would further complicate the existing drainage difficulty in Shiyáli taluk.

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ENCLOSURES.

I

*Letter*—from A. H. MORIN, Esq., Executive Engineer, Cauvery division.
*To*—the Superintending Engineer, V Circle.
*Dated*—the 11th December 1907.
*No.*—9356.

With reference to your No. 539 T.J., dated 21st June 1907, I have the honour to submit copy of a report by Mr. V. T. Srinivasa Aiyangar on the points raised by the Chief Engineer.

2. The Chief Engineer first criticises the assumption of duties of 44 and 66 for the Cauvery and Vennar respectively and states that these are not attained at present and that, in his opinion, they cannot be attained under existing circumstances.

3. The Sub-Engineer has not dealt with the Chief Engineer's points quite as closely as he might have done, but the gist of his first 8 paragraphs is that the restriction of supply at Cauvery-Vennar Regulator to a more economical duty is a matter of little or no importance, since, according to his figures, there actually is sufficient water available at Lower Anicut over and above the needs of the present Lower Anicut System wherewith to supplement the Palavar. He moreover proves that it is available *at the time when it is wanted*, therein differing from the conclusion arrived at by Colonel Smart in paragraph 17 of his report embodied in G.O., No. 523 I., dated 8th May 1902.

4. The Chief Engineer's second point is the apparent unaccountable waste at Cauvery-Vennar Regulator during July and August. This the Sub-Engineer deals with in his paragraph 13, and I believe that the reasons given by him are correct as far as they go. A much more accurate method of recording the progress of cultivation from the first flooding of the fields, than is at present in vogue, is very desirable from our point of view. Another reason which he has not given and which naturally would not come under his notice is that during the heavy south-west floods in July and August we almost invariably have to send more water down the Cauvery than is required, in order to prevent the shutters from being overtopped and at the same time keep the head down to the prescribed maximum.

5. The Chief Engineer's third point is with reference to the Siddamalli calingulah. With regard to this the Sub-Engineer has not made himself clear. There is a morai at this calingula under which it is closed for 1½ days in the week for the sole benefit of certain *high level lands* under the Siddamalli channel. The Sub-Engineer's proposals depended on the extent of these high level lands. If these were of sufficient extent to warrant the expense he proposed to do away with the *shutters* of the calingula and to gain command for these lands by extending the Vallam channel, which takes off four miles higher up. This is strictly in accordance with the principles laid down by Mr. Clerk for the remodelling of the delta. With this arrangement the calingula would act merely as an open drop. If the extent of high level lands proved to be comparatively small he proposed *to convert them into dry*, discontinue the morai and use the calingula only to maintain a water level suitable for the low level lands.

6. The Chief Engineer's fourth and last point is with reference to the alleged aggravation of floods in Chidambaram taluk owing to the absence of a head sluice for the Vadavar and in reply to this the Sub-Engineer gives facts and figures in support of his statement.

7. In compliance with paragraph 4 of the Chief Engineer's memorandum a map is submitted herewith showing all proposals in red.

8. All the enclosures to your No. 539 T.J., dated 21st June 1907, are returned herewith as per list attached.

II

*Letter*—from M.R.Ry. V. T. SRINIVASA AIYANGAR Avargal, Sub-Divisional Officer, Vennar.
*To*—the Executive Engineer, Cauvery division.
*Dated*—the 12th November 1907.

With reference to memorandum No. 2348, dated 17th June 1907, from the Chief Engineer for Irrigation forwarded with your letter No. 5104, dated 26th June 1907, I have the honor to report as follows.

2. The statement submitted by me with my first report seems to have created a belief that under the existing conditions of the Cauvery Delta, it will not be possible to give an early supply to the Palavar *viâ* the Lower Anicut without depriving the Cauvery and the Vennar of their legitimate supply and that the Palavar should wait therefore for the remodelling of the delta before it can expect to be improved.

3. I regret, I failed to give that required prominence to the fact that the Palavar can conveniently be helped without any such reservation; and that it can be done *viâ* the Lower Anicut alone successfully and with greater advantage. An unstinted and copious early supply the Coleroon has to spare, at the Lower Anicut during July, August and September under the existing conditions of the delta and without in the least interfering with the supply given to the irrigation at present under the Lower Coleroon Anicut system.

4. Statement N ("showing the supply available in the Coleroon") forwarded with my first report gives the supply available at the Lower Anicut under column 5 under existing conditions In statement O I have now entered in pencil figures the quantity of water that can conveniently be spared after satisfying the needs of irrigation under the Lower Anicut system as per details below :—

| Name of channel. | Discharge in cusecs at present full supply level. | Remarks. |
|---|---|---|
| The South Rajan Voikal .. | 445 | |
| The Kumukkramanniar .. | 130 | |
| The N. Rajan Voikal .. | 715 | |
| The Vadavar .. .. | 2,000 | After the improvements now in progress are completed. |
| Total .. | 3,290 or 3,300 cusecs. | |

5. A new statement has now been prepared from the pencil figures noted in the statement O ("statement showing the deficient supply in the Pudumanniyar") and it forms an enclosure [marked (*a*)] to this letter. It shows that the Palavar can without any trouble be helped to any extent *viâ* the Lower Anicut on an average for 14·6 days in July, 19·6 days in August, 11·8 days in September and 15·9 days in October.

6. The extent of such help has not in any way materially diminished, as was generally supposed; to that estimated by me originally, since the early freshes in the Aganda Cauvery bring down large volumes of water, and the saving effected by restricting the supply into the Cauvery and the Vennar at the Grand Anicut to a duty of 44 and 66 respectively forms but a fraction of the surplus—too little to be felt.

7. I have calculated the full supply in the Palavar at a fixed duty of 66, and from this have determined the extent of its deficiency. It is not possible to attain to this duty at the beginning of the irrigation season, when large volumes of water have to be poured into the fields to prepare them for cultivation. Experiments conducted by Mr. Howley in the Kistna Delta have shown that fields require 10·25″ of water over them to start cultivation. This estimate, I am sure, has to be increased by 50 per cent. more to represent the demands of lands in the Cavery Delta as the nature of their soil is more sandy and the facility of sub-soil drainage greater on account of greater fall of the country, amounting to 3 feet per mile on an average. Further, the absence of efficient drainage and fear of submersion, to which the lands under the Palavar are particularly subjected, would always create greater demand for water at the beginning of the cultivation season. Therefore the number af days of deficient supply in the Palavar during the earlier part of the season should be much more than what has been shown by me in statement A.

8. In the present conditions of the delta, it is altogether impossible to expect the Cauvery to help the Palavar to the desired extent, even with the aid of a direct channel as proposed from near the Vicramanar head. However full the Cauvery might run at its head, the want of control over minor regulation has always to be counted against the success of such a proposal. Whether half the amount of advantage that could be got by working the Palavar with the Lower Anicut, could be assured, would always remain a problem to solve, when the difficulties experienced in such well-ordered deltas as the Kistna and the Gódávari to send down adequate early supply to the tail-reaches are considered.

9. The proposal to supply the Palavar *viâ* the Lower Anicut would no doubt make the Cauvery Delta more complex by transferring the extent which has come to be considered to be an integral part of the delta to the Coleroon as well as Lower Anicut system; but I would suggest for serious consideration the inadvisability of denying the Palavar on such sentimental objections the advantages of a better supply, when facilities for giving it exist ready to hand, in favour of the distant prospect of improving it after the remodelling of the delta as a whole is completed, which I should say is a work of years.

10. It has been the experience of the several officers who have been connected with the Cauvery Delta that the system of supplementing the supply in a long channel at its lower course has several advantages. It lessens the initial cost of excavation as the channel can be made smaller; it gives greater facility to lands that drain into it in its upper reaches by shutting out at such times the supplemental supply; it minimises the wastage due to absorption, it renders regulation less difficult in the lower reaches of the channel by giving greater facility of supplying it direct without the wastage due to the abstraction of water in the upper reaches which would happen had the whole of the supply been admitted at the head alone, and it gives greater command to land in the upper reaches during periods of low supply, which are frequent, as the channel would then flow with a greater depth on account of its smaller section.

11. It is essential that the source from which such supplementing help is expected should possess the advantage of carrying the water let into it at the Grand Anicut with as little wastage as possible. The Coleroon is the only source that possesses this advantage. It flows in a valley; and has not much irrigation directly dependent on it before it reaches the Lower Anicut. The Cauvery on the other hand wastes a lot of water in leakage and absorption as it flows on a ridge. It has several main branches and minor channels taking off directly from it which would naturally obstruct a portion of the supplementing supply let into it, however carefully the sluices might be regulated before it reaches the head of the Vicramanar channel, wherefrom it is proposed to supply the Palavar.

12. The Manniar was never seriously considered by me as fitted to supplement the Palavar. The advisability of connecting the former with the Cauvery was suggested by me, as that step would improve the cultivation under the Manniar and at the same time indirectly benefit the Palavar. I do not propose to discuss here, why I preferred Vaduvagudi for its head, to the site proposed by the Executive Engineer, Cauvery division, in paragraph 16 of his letter No. 3291 of 18th April 1907, to the Superintending Engineer as it has no direct bearing on the Shiyali Project.

13. Under the Cauvery Delta, ryots generally allow the first fresh either to waste or to fill small ponds or village tanks to aid them in raising seedlings; when the river has steadied, supply is given first to lands that grow two crops and these are flooded, prepared and then transplanted with seedlings raised previously. Fields on which seedlings are raised for lands that grow single crops are supplied next and these generally form 12 per cent. of the total extent under cultivation. Any excess supply is then diverted to flood the other lands and there the water is allowed to stagnate till their turn for transplanting comes. It is only very rarely therefore that early supply is wanted. The low duty deduced by the Chief Engineer is due more to the inaccuracy of the statement showing the progress of cultivation during each month supplied by the Revenue Department. This statement is generally compiled from the reports submitted every month by the village accountants whose work in this line are very rarely subjected to scrutiny. Fields that have either been flooded in advance or prepared but have not been transplanted are excluded from this statement.

14. The progress of cultivation during each month of an irrigation season should have attained a fixity especially in such an old delta as the Cauvery and is not likely to vary much unless the existing conditions of the delta are altered. The duty deduced therefore from the total extent of irrigation in the delta would give as much facility in comparing the efficiency of an irrigation system. Statement W ("statement of average existing supply with the duty arrived: Cauvery delta system") gives the average duties obtained according to this method during each month of the irrigation season and they are as follows:—

| Month. | Duty. |
|---|---|
| July | 48 |
| August | 53 |
| September | 69 |
| October | 71 |
| November | 129 |
| December | 627 |

15. The constant discharge of 14,973 cusecs assumed by me gives an average duty of 55 for the whole delta. The supply at this rate becomes insufficient during July alone when there is more than enough water to spare. However, I have not in the present report taken into account the supply that can thus be spared; but have allowed the existing state of things to continue. The supply available at the Lower Anicut still shows surplus more than enough to supply the Palavar five times over.

16. While dealing with the South Rajan Voikal, I proposed two alternatives with a view to do away with the turn at the Sidhamalli calingula. The one was to supply the lands under the channel from the calingula by extending the Vallam channel and the other to leave the calingula and the existing channel as they are and to discontinue the practice of closing the calingula by shutters. The first I proposed to adopt if the high level lands under the existing channel are sufficient to warrant an outlay of Rs. 4,000 and the second where the high level lands do not amount to more than 30 acres. I had to suggest alternative proposals as I was not sure of the extent of high level fields.

17. The Coleroon has been in high floods during the monsoons. In 1858 the heaviest flood occurred in November, when the Chidambaram taluk was suffering from heavy local drainage. The maximum flood of 1882 was in July. With a head sluice for the Vadavar the damages that occurred in 1882 would have been completely averted while the greater portion of the remission granted would have been saved in 1858.

18. The Vadavar when running at its full supply level would carry 2,000 cusecs after the improvements now in progress are completed and during such floods as those of 1858 and 1882, it would have carried as much as 6,000 cusecs, not an inconsiderable amount when the general practice of designing the drains to carry only 2 inches rainfall over the basin in 24 hours is considered.

19. In the present instance the Veeranam tank has sufficient surplusing facilities and arrangements exist to discharge 17,500 cusecs (the maximum amount of surplus as observed). But the surplus channel below is cramped, and is not able to carry more than a fraction of it. The whole drainage collects above the Komaratchi bridge, and the depth of water for miles round is more than 6 feet, as calculated by Colonel Smart. During last year the discharge over the tank weirs was barely 4,000 cusecs, yet the surplus channel got congested and with the local rains caused large submersion and heavy loss.

A sluice at the head would have greatly reduced the congestion and lessened the duration of submersion.

This was one of the several reasons which induced me to propose a head sluice.

(*a*)—Statement showing number of days water can be spared for the Palavar from the Lower Anicut, Coleroon, after meeting the existing demands.

| — | 1887. | 1888. | 1889. | 1890. | 1891. | 1892. | 1893. | 1894. | 1895. | 1896. | 1897. | 1898. | 1899. | 1900. | 1901. | 1902. | 1903. | 1904. | Average. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| July .. .. .. | .. | 20 | 11 | 7 | 15 | 16 | 3 | 9 | 10 | 25 | 12 | .. | 14 | 31 | 19 | 14 | 16 | 26 | 14·6 |
| August .. .. | .. | 26 | 22 | 15 | 18 | 29 | 10 | 19 | 28 | 27 | 29 | 16 | .. | 31 | 20 | 3 | 27 | 14 | 19 6 |
| September .. .. | 4 | 2 | 30 | .. | .. | 13 | 6 | 3 | 5 | 17 | 17 | 12 | 10 | 30 | 9 | 14 | 27 | 3 | 11·8 |
| October .. .. | 20 | 4 | 30 | 8 | 13 | 1 | 19 | 4 | 18 | 14 | 23 | 25 | 2 | 31 | 19 | 17 | 27 | 11 | 15·9 |

## VI

### Note by the Chief Engineer for Irrigation.

In G.O., No. 1780 W., dated 24th August 1906, Sub-Engineer Mr. V. T. Srinivasa Aiyangar was posted for duty under Mr. Morin, Executive Engineer, Tanjore division, (1) to investigate the question of the existing defective supply of water to the Shiyali taluk and to suggest measures for its improvement and (2) to enquire into the question of the "Morai" or distribution of water by turns to be arranged at the Lower Anicut so as to safeguard as far as possible the conflicting interests of the channels taking off therefrom on both sides of the anicut. In paragraph 4 of the same order the Superintending Engineer, V Circle, was asked to consider the question of the distribution of water under the Cauvery and its branches in consultation with the Collector and submit a report in due course to the Chief Engineer for Irrigation.

2. In April 1907 the undersigned when Superintending Engineer, V Circle, submitted a communication received from the Collector of Tanjore on the question of the Cauvery-Vennar morai, wherein the latter stated that without the opinion of a technical expert on the detailed effect of the proposals and a consideration of the legal aspect of the question, it would be most dangerous to make any innovation. The report on the results of the enquiries entrusted to Mr. V. T. Srinivasa Aiyangar was awaited, as both the questions were mixed up.

3. With his No. 157-E.I., dated 1st May 1907, the Superintending Engineer, V Circle (Mr. Pears), submitted the preliminary report by Mr. V. T. Srinivasa Aiyangar together with Mr. Morin's letter No. 3291, dated 18th April 1907, expressing his opinion on the subject. The Sub-Engineer investigated the questions in detail and arrived at the following conclusions:—

(1) That the whole Cauvery delta, and the Lower Anicut system in particular, require remodelling in view to increasing their efficiency,

(2) That the remodelling of the Lower Anicut system need not wait for that of the delta which cannot be done without an Irrigation Act,

(3) That the Lower Anicut system, if remodelled, will not only secure sufficient supply for its own requirements, but will set free enough water to supplement the Palavar,

(4) That the remodelling of the whole delta will still further improve these conditions,

(5) That during a portion of the year, the lands under the Palavar in Shiyali taluk can, with the help of the north-east monsoon, be independent of any supply from the delta,

(6) That about 2,000 cusecs can be made available at the Lower Anicut for use elsewhere than in the same system,

(7) That the Cauvery can afford to spare enough water during July, August and September to enable the Palavar to make an early start with its cultivation,

(8) That the advantages of supplementing the Palavar from the Coleroon or the Cauvery are about equal, and

(9) That the Vadavar has the prior claim to consideration.

4. The measures suggested by the Sub-Engineer for improving the existing state of affairs are:—

(*a*) The internal improvement of the North and South Rajan Voikals, the Vadavar and the Khan Sahib's Canal with a view to increasing their duty and thereby setting free some of the water available at the Lower Anicut for the benefit of the Palavar,

(*b*) Similar improvement of the Palavar itself with a view to reducing the supplemental supply required to a minimum,

(*c*) Direct supplementing of the Palavar from the Lower Anicut by means of an independent channel therefrom and in parallel to the Kumukkumanniar, and

(*d*) Indirect supplementing of the Palavar by means of a channel connecting the Cauvery with the Manniar near Vaduvagudi surplus.

The several works proposed to carry out the above measures are detailed in paragraphs 6 to 8 of the Executive Engineer's letter No. 3291, dated 18th April 1907.

5. The Executive Engineer, Tanjore Division, is of opinion that the remedies proposed by the Sub-Engineer in connection with the irrigation of the Lower Anicut system which commands lands both in the Tanjore and South Arcot districts, such as the abolition of unnecessary regulators and reduction of direct distributaries to a minimum, appear to be in the right direction. He states that he has no personal knowledge of the drainage on the South Arcot side, but that the proposals for the Tanjore side seem to be sound and feasible, though he is inclined to think that it would be a great advantage if the tide water is excluded from the outlets in the case of the Kittianai Uppanar. With regard to the modification of the sanctioned scheme for improving the Vadavar head proposed in paragraph 37 (*d*) of the Sub-Engineer's report, the Executive Engineer says that, as the acting Chief Engineer for Irrigation is thoroughly conversant with the question, it is unnecessary to say anything beyond that he deprecates any proposal to refrain from lowering the crest of the Lower Anicut throughout, as this improvement will be of the greatest help in the solution of the difficult question of the exclusion of flood water from the delta. In any case he is of opinion that the Palavar system cannot expect help from the Coleroon, unless and until the inherent defects in the Lower Anicut system have been remedied. At the same time he does not like the proposal to supplement the Palavar direct from the Cauvery by means of an offtake as high up as the Vaduvagudi

surplus *viâ* Manniar. For he says that the Manniar is already directly connected with the Cauvery by the Perumalcoil surplus, 13 miles further east, but is itself badly in need of help and in times of short supply cannot spare much water for the Palavar or Pudumanniar. If at all the Palavar is to be supplemented by the Cauvery, he suggests that, as it is well enough served in its upper reaches, it would be to the advantage of the Pudumanniar to receive its direct supply from the Cauvery at a point as far east as possible. He considers the Vikramanar, a large distributary taking off from the Cauvery 70 miles east of Grand Anicut, an ideal means of affording this direct supply as an extension of it by a mile would reach the point where the Ayyavaiyanar branches from the Palavar or a mile above the infall of the Manniar and about 6 miles above the Uppandam.

6. With regard to the revision of the Cauvery-Vennar morais, the Executive Engineer suggests that if an Irrigation Act may be expected in the near future, the question may be allowed to lie over, as with such an Act, the Public Works Department would have the power to close sluices in the upper reaches when necessary, without which the full benefit of revision could not be secured, and that it is even probable that such power would render any revision unnecessary.

7. The Superintending Engineer, V Circle (Mr. Pears), in forwarding the Sub-Engineer's report states that the Cauvery, rather than the Coleroon, is the proper source of supply to the Palavar irrigation in the Shiyali taluk for the following reasons :—

(*a*) There is intimate connection between the Shiyali taluk and the Cauvery Delta.

(*b*) The Vikramanar is ready to hand to bring in a supply by its extension for about a mile as suggested by Mr. Morin.

(*c*) The drainage of the Shiyali taluk will be easier if it consists only of the surplusage of the Kumbakónam and Máyavaram taluks, than of the surplusage of the above taluks together with an independent discharge from the Lower Anicut.

The Superintending Engineer further states that, although the remodelling of the whole Cauvery delta system will take a longer time than that of the Lower Anicut system and a supplementary supply can be brought in from the latter system to the Palavar a few years sooner, it would be shortsighted to do the wrong thing now rather than wait for the right thing. The Superintending Engineer is also of opinion that the Sub-Engineer's contention that the reorganisation of the Lower Anicut system will save enough water for the Palavar is quite open to question, as readings of water levels are evidently not to be too much relied on and as there may be many obvious errors.

8. With regard to the Cauvery and Vennar morais, the Superintending Engineer recommends that their revision should await the Irrigation Act and that if revised now, they would probably have to be revised again when the Act is passed, giving rise to trouble meanwhile.

As to the improvements of the North and South Rajan Voikals, Khan Sahib's canal and Pasumuthan Odai suggested by the Sub-Engineer, Mr. Pears states that there seems no reason why their investigation should not be gone on with, but adds that he has not the requisite local knowledge for forming an opinion as to their urgency and suitability and the possibility of carrying them out, till the Irrigation Act is passed.

9. The papers were returned to the Superintending Engineer, V Circle, with this office Memorandum No. 2348, dated 17th June 1907, with the following remarks :—

(1) That all the tables drawn up by the Sub-Engineer are based on an assumed duty of 44 and 66 for the Cauvery and Vennar respectively at the Grand Anicut and that these duties are not attained at present.

(2) That unless the existing conditions of the Cauvery delta are altered, it is impossible to think of giving an early supply to the Palavar from the Lower Anicut, while it is evident that enormous quantities of water are passed through the delta without being used early in the season.

(3) That it is not clear what advantage would be obtained by doing away with the Siddamalli calingulah of the South Rajan Voikal, if it is proposed to retain the existing head without dam.

(4) That the Sub-Engineer in discussing the proposal to construct a head sluice to the Vadavar, states that the supply down it into Veeranam tank tends to increase the floods in Chidambaram taluk by prolonging the period of submersion, while it is presumed that when there are severe floods in Chidambaram taluk, the level in the Coleroon at Lower Anicut is not high enough to give any large discharge down the Vadavar.

10. The Superintending Engineer now forwards the Sub-Engineer's reply to the above memorandum together with the Executive Engineer's remarks thereon. The Sub-Engineer has not fully answered the first point of the memorandum but simply gives some figures to show that there is actually sufficient water available at the Lower Anicut over and above the needs of the system wherewith to supplement the Palavar.

With regard to the unaccountable waste at the Cauvery-Vennar regulators during July and August, the Sub-Engineer states that the ryots generally allow the first freshes either to waste or to fill small ponds or village tanks to help them in raising seedlings. When the river has steadied, its supply is given first to lands that grow two crops and these are flooded, prepared and then transplanted with seedlings raised previously, any excess supply being then diverted to flood the other lands; it is only very rarely the early supply is used. Mr. Morin adds that during the south-west floods more water is invariably sent down the Cauvery than is actually required in order to prevent the shutters from being overtopped and at the same time keep the head down to the prescribed maximum.

With regard to the Siddamalli calingula the Executive Engineer states that there is a morai at this calingula under which it is closed for 1½ days in the week for the benefit of certain high level lands under the Siddamalli channel, and that if these lands are of sufficient extent, it is proposed to do away with the shutters of the calingula and to gain command for these lands by extending the Vallam channel taking off 4 miles higher up. In paragraphs 17 to 19 of his report dated 12th November 1907, the Sub-Engineer gives facts and figures to support his statement that the absence of a head sluice for the Vadavar increases floods in the Chidambaram taluk.

11. There are two methods proposed to improve the supply to the Palavar and Pudumanniar: (1) by the Cauvery from the Grand Anicut and (2) from the Coleroon Lower Anicut. The first can only be done by improving and remodelling the Cauvery below the Grand Anicut. It has been assumed that the latter can be done at once, but this is not the case. All the tables which lead up to statement A depend on assumed duties of 44 for Cauvery, and 66 for Vennar, irrigation and these are not worked to at present and cannot be under existing conditions.

Mr. Srinivasa Aiyangar has not fully explained the above points. Statement N, column 5, gives the amount of surplus available, but from this must be deducted the excesses shown in column 3. This very largely reduces the supply available until the Tanjore delta proper is remodelled.

12. It is admitted that no water can be spared until the North and South Rajan Voikals are made to work to a duty of 66 this being for July and August presumably a maximum capacity duty. To show what the existing duties are, the accompanying tables have been compiled, the areas under cultivation having been computed as accurately as circumstances will admit. The discharges are those arrived at by gaugings taken by the Sub-Engineer. No account has been taken of the fact that lands under preparation were excluded from the Revenue accounts. We may therefore take the area shown as under cultivation in August as really taking water in July and that shown in September as the area supplied in August. On this assumption the average monthly duties are as follows:—

| | July. | August. | September. |
|---|---|---|---|
| North Rajan Voikal ... ... ... ... | 13 | 18 | 38 |
| South Rajan Voikal ... ... ... ... | 8 | 15 | 32 |

The above figures may be taken to represent fairly well what the monthly duties of these two channels are at present, and also to indicate to some extent what the duties of the Cauveri Delta system would be during those months, if flood water were excluded from the delta.

13. Mr. Srinivasa Aiyangar admits that an extra supply cannot be given to the Palavar without remodelling the North and South Rajan Voikal channels and thinks that this can be done at once. Mr. Morin, the Executive Engineer, considers that it cannot be done till an Irrigation Act is passed. The undersigned agrees with Mr. Morin. The work proposed is exactly on the lines proposed by the Acting Chief Engineer for Irrigation for the Tanjore delta generally and may be approved, but it would probably meet with strong opposition and should be undertaken after the Act is passed, either as part of a scheme of remodelling the entire delta or sepa-pately as may then be found most convenient.

14. There are, however, certain works suggested some of which would improve the irrigation of Shiyali taluk. These are intended to improve the drainage thereby subjecting growing crops to less submersion and allowing the late crops to be started earlier. Such works as these do not interfere with existing rights and there is no objection to their consideration by the Superintending Engineer who, if he finds on investigation that the benefits to be derived are commensurate with the cost of the proposed works, is at liberty to submit estimates for them. These works are—

*A. South Arcot District.*

(1) Demolishing the two regulators across the Pasumuthan Odai, providing the road bridge above Tilliamman surplus with shutters and providing a side channel for the lands now under these two regulators.

(2) Removing the left bank of the same odai and widening the odai so as to include the Buthangudi drain.

(3) Digging a straight cut from the Pasumuthan odai to the Vellar.

(4) The improvements to Khan Sahib's canal enumerated in paragraph 6 (4) of Mr. Morin's letter No. 5291, dated 18th April 1907.

(5) Widening and straightening the Uppanar and widening the old Coleroon.

(6) Making a straight cut from the Uppanar to the back water.

*B. Tanjore District.*

(1) Widening the Vellapalam Uppanar from Uppan dam to the sea.

(2) Improving the minor drains at the tail end of the Cauvery.

(3) Widening and deepening the Vellangudi drain.

(4) Disconnecting the Kittianai Uppanar from the Coleroon by cross-bunding it and diverting it into the sea, south of Devikota.

15. As the existing rules for the regulation of water at the Lower Coleroon anicut have given dissatisfaction to the ryots on the Tanjore side of the river, their revision has been under correspondence for some time past. Fresh rules recently received from the Superintending Engineer, V Circle, have been approved by the undersigned and, before placing before Government, the Superintending Engineer has been asked to obtain the approval of the Collectors of Tanjore and South Arcot districts thereto.

16. The Sub-Engineer's proposal to take a separate channel for the lands now directly irrigated by the Vadavar and his criticisms on the work sanctioned in G.O., No. 944 I., dated 1st September 1906, do not commend themselves to the undersigned.

17. The undersigned agrees with Mr. Pears that the revision of the Cauvery Vennar morais may await the passing of the Irrigation Act.

*6th April* 1908.

H. E. Clerk,
*Ag. Chief Engineer for Irrigation.*

## ENCLOSURES.

STATEMENT showing the area under cultivation, water-supply and duty under the South Rajan Voikal in Máyavaram and Shiyali taluks.

| — | Area brought under irrigation. | Increase or decrease in area. | Difference balance on ground. | Average discharge at head in c. ft. per second. | Duty per c. ft. per second. | Average rainfall in the irrigated area. |
|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| | ACS. | ACS. | ACS. | * | ACS. | INCHES. |
| **Fasli 1312 (1902–1903).** | | | | | | |
| July .. .. .. | 66 | +66 | 66 | 311 | .. | 0·91 |
| August .. .. .. | 2,914 | +2,914 | 2,980 | 399 | 8 | 2·40 |
| September.. .. .. | 3,888 | +3,888 | 6,868 | 410 | 17 | 5·48 |
| October .. .. .. | 6,445 | +6,445 | 13,313 | 329 | 40 | 18·55 |
| November.. .. .. | 1,904 | 66+1,838 | 15,151 | 113 | 134 | 18·97 |
| December .. .. .. | 773 | 2,914—2,141 | 13,010 | 120 | 108 | 16·22 |
| January .. .. .. | 388 | 3,888—3,500 | 9,510 | 249 | 38 | 2·19 |
| February .. .. .. | 156 | 6.445—6,289 | 3,221 | .. | .. | 0·21 |
| March .. .. .. | 22 | 1,904—1,882 | 1,339 | .. | .. | 0·06 |
| **Fasli 1313 (1903–1904).** | | | | | | |
| July .. .. .. | 62 | +62 | 62 | 269 | .. | 1·34 |
| August .. .. .. | 2,170 | +2,170 | 2,232 | 457 | 5 | 4·32 |
| September .. .. .. | 3,931 | +3,931 | 6,163 | 405 | 15 | 13·09 |
| October .. .. .. | 7,692 | +7,692 | 13,855 | 358 | 39 | 4·92 |
| November .. .. .. | 1,700 | 62+1,638 | 15,493 | 404 | 39 | 6·91 |
| December .. .. .. | 630 | 2,170—1,540 | 13,953 | 431 | 32 | 17·06 |
| January .. .. .. | 523 | 3,931—3,408 | 10,545 | 221 | 48 | 4·27 |
| February .. .. .. | 266 | 7,692—7,426 | 3,110 | .. | .. | 0·03 |
| March .. .. .. | 62 | 1,700—1,638 | 1,481 | .. | .. | .. |

* These figures have been taken from Mr. V. T. Srinivasa Aiyangar's tables of discharges by actual gauging.

*Note.*—Rainfall figures denote the average of the three stations, Shiyali, Neidavasal and Máyavaram.

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STATEMENT showing the area under cultivation, water-supply and duty under the South Rajan voikal in Máyavaram and Shiyali taluks.

| — | Area brought under cultivation. | Increase or decrease in area. | Difference balance on ground. | Average discharge at head in c. ft. per second. | Duty per c. ft. per second. | Average rainfall in the irrigated area. |
|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| | ACS. | ACS. | ACS. | * | ACS. | INCHES. |
| **Fasli 1314 (1904–1905).** | | | | | | |
| July .. .. .. | 375 | + 375 | 375 | 389 | .. | 1·91 |
| August .. .. .. | 3,138 | +3,138 | 3,513 | 445 | 8 | 5·36 |
| September .. .. | 4,716 | +4,716 | 8,229 | 325 | 25 | 4·61 |
| October .. .. .. | 5,702 | +5,702 | 13,931 | 436 | 32 | 7·27 |
| November .. .. | 1,783 | 375+1,408 | 15,339 | 324 | 48 | 2·42 |
| December .. .. .. | 733 | 3,138—2,405 | 12,934 | 189 | 68 | 8·38 |
| January .. .. .. | 211 | 4,716—4,505 | 8,429 | 81 | 104 | 0·19 |
| February .. .. .. | 114 | 5,702—5,588 | 2,841 | .. | . | .. |
| March .. .. .. | 7 | 1,783—1,776 | 1,065 | .. | .. | 0·21 |
| **Fasli 1315 (1905–1906).** | | | | | | |
| July .. .. .. | 46 | + 46 | 46 | 352 | .. | 1·38 |
| August .. .. .. | 2,595 | +2,595 | 2,641 | 473 | 6 | 4·98 |
| September .. .. | 4,326 | +4,326 | 6,967 | 500 | 14 | 4·39 |
| October .. .. .. | 4,158 | +4,158 | 11,125 | 288 | 39 | 16·84 |
| November .. .. | 2,719 | 46+2,673 | 13,798 | 316 | 44 | 13·97 |
| December .. .. .. | 545 | 2,595—2,050 | 11,748 | 215 | 55 | 1·21 |
| January .. .. .. | 246 | 4,326—4,080 | 7,668 | .. | .. | .. |
| February .. .. .. | 106 | 4,158—4,052 | 3,616 | .. | .. | .. |
| March .. .. .. | 14 | 2,719—2,705 | 911 | .. | .. | .. |

* These figures have been taken from Mr. V.T. Srinivasa Aiyangar's tables of discharges by actual gauging.

*Note.*—Rainfall figures denote the average of the three stations, Shiyali, Neidavasal and Máyavaram.

STATEMENT showing the area under cultivation, water-supply and duty under the North Rajan Voikal in Chidambaram taluk.

| — | Area brought under irrigation. | Increase or decrease in area. | Difference balance on ground. | Average discharge at head in c. ft. per second. | Duty per c. ft. per second. | Average rainfall in the irrigated land. |
|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| | ACS. | ACS. | ACS. | * | ACS. | INCHES. |
| **Fasli 1312 (1902–1903).** | | | | | | |
| July .. .. .. | 184 | + 184 | 184 | 384 | .. | 2·47 |
| August .. .. .. | 6,296 | +6,296 | 6,480 | 643 | 10 | 3·19 |
| September .. .. | 6,784 | +6,784 | 13,264 | 555 | 24 | 5·68 |
| October .. .. .. | 7,125 | +7,125 | 20,389 | 319 | 64 | 14·82 |
| November .. .. | 1,660 | 184+1,476 | 21,865 | 87 | 251 | 15·08 |
| December .. .. .. | 153 | 6,296—6,143 | 15,722 | 149 | 105 | 24·81 |
| January .. .. .. | 160 | 6,784—6,124 | 9,598 | 216 | 44 | 1·94 |
| February .. .. .. | 41 | 7,125—7,084 | 2,51 | .. | .. | 0·35 |
| March .. .. .. | 68 | 1,660—1,592 | 922 | .. | .. | .. |
| **Fasli 1313 (1903–1904).** | | | | | | |
| July .. .. .. | 129 | + 129 | 129 | 279 | .. | 3·17 |
| August .. .. .. | 3,898 | + 3,898 | 4,027 | 673 | 6 | 4·85 |
| September .. .. | 4,964 | + 4,964 | 8,991 | 457 | 19 | 14·28 |
| October .. .. .. | 10,282 | +10,282 | 19,273 | 594 | 33 | 3·01 |
| November .. .. | 2,167 | 129+ 2,038 | 21,311 | 426 | 50 | 5·45 |
| December .. .. .. | 284 | 3,898 - 3,614 | 17,697 | 538 | 33 | 10·92 |
| January .. .. .. | 263 | 4,964— 4,701 | 12,996 | 268 | 48 | 2·23 |
| February .. .. .. | 159 | 10,282—10,123 | 2,873 | .. | .. | .. |
| March .. .. .. | 80 | 2,167— 2,087 | 786 | .. | .. | .. |

* These figures have been taken from Mr. V. T. Srinivasa Aiyangar's tables of discharges of actual gauging.

*Note.*—Rainfall figures denote the average of the three stations, Bhuvanagiri, Mannargudi and Chidambaram.

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STATEMENT showing the area under cultivation, water-supply and duty under the North Rajan Voikal in Chidambaram taluk.

| — | Area brought under cultivation. | Increase or decrease in area. | Difference balance on ground. | Average discharge at head in c. ft. per second. | Duty per c. ft. per second. | Average rainfall in the irrigated area. |
|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| | ACS. | ACS. | ACS. | * | ACS. | INCHES. |
| **Fasli 1314 (1904–1905).** | | | | | | |
| July .. .. .. | 63 | + 63 | 63 | 463 | .. | 2·49 |
| August .. .. .. | 5,646 | + 5,646 | 5,709 | 740 | 8 | 3·44 |
| September .. .. | 7,131 | + 7,131 | 12,840 | 488 | 27 | 5·54 |
| October .. .. .. | 7,425 | + 7,425 | 20,265 | 444 | 46 | 7·19 |
| November .. .. .. | 1,559 | 63 + 1,496 | 21,761 | 489 | 45 | 5·67 |
| December .. .. .. | 86 | 5,646 — 4,760 | 17,001 | 309 | 55 | 7·44 |
| January .. .. .. | 219 | 7,131 — 6,912 | 10,[illegible]89 | 163 | 62 | 0·50 |
| February .. .. .. | 91 | 7,425 — 7,334 | 2,755 | .. | .. | .. |
| March .. .. .. | 35 | 1,559 — 1,524 | 1,231 | .. | .. | 0·03 |
| **Fasli 1315 (1905–1906).** | | | | | | |
| July .. .. .. | 35 | 35 | 35 | 494 | .. | 1·82 |
| August .. .. .. | 5,908 | + 5,908 | 5,943 | 574 | 10 | 8·52 |
| September .. .. | 6,914 | + 6,914 | 12,857 | 672 | 19 | 3·06 |
| October .. .. .. | 7,270 | + 7,270 | 20,127 | 276 | 73 | 18·17 |
| November .. .. .. | 1,896 | 35 + 1,861 | 21,988 | 203 | 108 | 11·72 |
| December .. .. .. | 190 | 5,908 — 5,718 | 16,270 | 328 | 50 | 0·24 |
| January .. .. .. | 119 | 6,914 — 6,785 | 9,485 | .. | .. | .. |
| February .. .. .. | 166 | 7,270 — 7,104 | 2,381 | .. | .. | .. |
| March .. .. .. | 23 | 1,896 — 1,873 | 508 | .. | .. | .. |

* These figures have been taken from Mr. V. T. Srinivasa Aiyangar's tables of discharges by actual gauging.

*Note.*—Rainfall figures denote the average of the three stations, Bhuvanagiri, Mannargudi and Chidambaram.

**Order—No. 272 I., dated 24th June 1909.**

The proposals of the Chief Engineer for Irrigation are approved.

2. The attention of the Superintending Engineer, V Circle, is drawn to paragraph 14 of the foregoing note by the Chief Engineer for Irrigation.

(True Extract.)

C. A. SMITH,
*Joint Secy. to Govt., P.W.D.,*
*Irrigation Branch.*

To the Chief Engineer for Irrigation.
,, Superintending Engineer, V Circle.
,, Examiner, Public Works Accounts.
,, Board of Revenue (Revenue Settlement).

Copy to the Revenue Department.

# Government of Madras.

PUBLIC WORKS DEPARTMENT.

IRRIGATION.
ESTABLISHMENT.

| | | |
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| *Regd.* | | *Spare copies* |

## G.O., No. 273 I., 28th June 1909.

**Special Revenue Establishment, Kistna Reservoir Project.**

Extending to the end of October 1909 of the period of appointment of the — sanctioned in G.O., No. 166 I., dated 15th April 1909.

GOVERNMENT OF MADRAS.

PUBLIC WORKS DEPARTMENT.

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**Irrigation.**
**Establishment.**

Read—the following papers :—

I

**G.O., No. 166 I., dated 15th April 1909.**

Abstract.—Approving, with remarks, the recommendation made by the Chief Engineer for Irrigation for the entertainment of the establishment required for the revenue investigation of the Kistna Reservoir Project.

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II

**G.O., No. 276, Public, dated 24th April 1909.**

Abstract.—Placing Mr. J. M. Turing, I.C.S., on special duty in connection with the revenue investigation of the Kistna Reservoir Project for a period of three months and fixing his salary whilst so employed.

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III

Reference from the Board of Revenue (Revenue Settlement), C. No. 1090, dated 11th May 1909.

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IV

**Memorandum Ref. on Cur. No. 218/09-1, dated 22nd May 1909.**

With reference to the correspondence ending with its Reference, No. 1090, dated 11th May 1909, regarding the revenue investigation of the Kistna Reservoir Project, the Board of Revenue (Revenue Settlement) is informed that it is proposed for the present to defer the investigation for the upland canal and that Mr. Turing, the Special Revenue Officer, may be instructed to carry out first the investigation for extensions in the Kistna delta.

(By Order.)

T. W. S. Smyth,
*Asst. Chief Engineer for Irrigation.*

To the Board of Revenue (Revenue Settlement).

V

**Reference from the Board of Revenue (R.S., Sur., L.R. and Agri.), No. 1323, dated 11th June 1909.**

*Read*—the following papers :—

*Letter*—from J. M. TURING, Esq., I.C.S., Special Revenue Officer, Kistna Reservoir Project, Guntúr.
*To*—the Secretary to the Commissioner of Revenue Settlement, Survey, Land Records and Agriculture.
*Dated*—Camp Vetapalem, the 4th June 1909.
*No.*—R.C. 127.

I have the honour to address the Board giving a brief description of the work involved in my investigation of the revised Kistna Reservoir Project, and to request that the Board will recommend to Government a short extension of the period of my deputation on special duty, the exact length of this extension to depend on the decision of the point raised below in paragraph 10.

2. The officers of the Public Works Department have been supplying me from time to time with the information I require regarding the exact areas commanded.

The proposed extensions of irrigation in the Kistna delta, I may explain, consist of about 150 scattered blocks, as a rule covering portions of villages only, and which therefore cannot be identified by natural or village boundaries. The blocks are troublesome to define, and it is natural that there should have been some delay in the matter.

My information as to what is finally to be treated as commanded by the project, is even now not fully complete, but I know enough to make a tolerably accurate forecast of what is to be done and how long it will take.

3. The work to be done falls under the following main heads :—

(1) The upland canal area in the Guntúr district.

(2) The delta extensions in the Eastern and Western deltas under ordinary first crop.

(3) Divi island.

(4) Second crop both in the upland and the delta.

(5) Short late crop on the big swamps.

(6) Inspection of the area to be submerged under the reservoir (or aniout should the project finally take this shape) on both sides of the Kistna river, part of this being in British territory and part in that of His Highness the Nizam.

4. As regards (1) the upland area, the Board, in accordance with Reference on Current No. 218-1 of 1909, dated 22nd May 1909, of the Chief Engineer for Irrigation, has, in Board's Proceedings, Mis. No. 1770, dated 25th May 1909, ordered that it shall be postponed for the present, and I have addressed the Board in this office R.C. No. 100 of 1909, dated 4th June 1909, recommending that, as the work consists of little but an office check, it may proceed for the present.

Whether it is ultimately decided to include or exclude this area, I do not anticipate being obliged to do any field work personally in connection with it. It has involved several days' office work already and a good deal of correspondence, but the work still to be done will not make much difference to the period of my deputation, so far as I can see at present.

(2) As regards Divi island, the Superintending Engineer, II Circle, has requested that the area ultimately irrigable may be treated as part of the area commanded by the reservoir, the idea being to irrigate it by gravitation after the present pumping plant is worn out, instead of renewing the latter.

I understand, though not officially, that Government has recently sanctioned a special establishment under a Deputy Collector to do the revenue investigation work in Divi.

Except as far as my report is concerned, therefore, Divi island will be outside the scope of my work. Presumably I shall include rough figures in my report, which will be corrected later with reference to the work of the Special Deputy Collector.

(3) As regards sub-paragraph (4) of paragraph 3 (second crop), it may involve some personal enquiries, but no field work. It is mainly a question of ascertaining how far the present habits of the Gódávari delta ryot will be adopted by the Kistna delta ryot when water becomes available, and will involve more correspondence than anything else.

5. I next come to the three remaining branches of work [sub-paragraphs (2), (5) and (6) of paragraph 3] which include practically the whole of the field work to be done, and are the only branches which materially affect the period of my deputation.

The bulk of the work falls under item (2) delta extension, ordinary first crop. The area involved in the two districts is about 150,000 acres.

In accordance with G.O., No. 166, dated 15th April 1909, I have entertained only part of the establishment sanctioned, two Tahsildars and six Revenue Inspectors instead of three Tahsildars and nine Revenue Inspectors up to date.

I now think that this establishment will finish the above work, together with such part of the work described in paragraph 7 as falls on my subordinates, about the time that my special duty closes according to present orders (4th August 1909), which would, of course, be too late for the purposes of my report.

It took about a fortnight to get the establishment out in the field. So, this would represent about 2½ months' actual field work, and is not unreasonable, I think, for the area involved, particularly in view of the scattered nature of the lands. Their scattered position naturally adds greatly to the time wasted in getting from one block to the other.

I could however reduce the time occupied, say, by ten or fifteen days, by adding another Revenue Inspector or two, and would do so, were it not that the extension of time is more needed for my own personal work than for that of my establishment for the reasons given in the paragraph following.

6. I do not intend to attempt visiting any of the less important of the 150 or so blocks scattered up and down the delta, but there are two ordinary blocks, one measuring about 30,000 acres, and one over 10,000 which I certainly ought to inspect.

Further, there are included in the area irrigable the lands previously commanded by the Pedda Lanka and Iskapalle projects (alluded to in paragraph 11 of Board's Proceedings, No. 210, dated 14th July 1905, printed at page 155 of the report on the Kistna Reservoir Project).

As the attempt to irrigate these lands has already been made, and failed for want of population, or similar reasons unconnected with the actual supply of water, the propriety of their present inclusion is on of the face of it extremely doubtful and certainly requires, or so it seems to me, my personal investigation.

Again some of the lands shown as suitable for ordinary *first* crop (apart from the lands dealt with in the next paragraph) are, I now find, swamp lands, and in the case of the Romperu swamp, where I am now working, depend not only on the Reservoir scheme, but on separate drainage schemes for their irrigation to be successful.

This item of work also cannot be left to a subordinate.

7. There is also the work in connection with the fifth item of paragraph 3 (short late crop on swamp lands). This, so far as I know, is a new experiment in irrigation, the idea being to induce the ryots of neighbouring villages to plant a short paddy crop in the second-crop season in the beds of the great swamps as the water recedes in December and January, and to supply them with reservoir water after the swamp is dry.

The area which I am asked to investigate with reference to this question is very large, about 50,000 acres, and involves about a third, I believe, of the Kolair lake, together with two different extents of considerable size and widely separated in the Guntúr district.

It needs no argument, I think, to prove that a cultivation experiment on such a scale, and so unusual, needs careful personal enquiry, before it can be admitted as one of the assets of an irrigation scheme.

8. These are the items of work which seem to me to require my personal investigation. The Board will, I think, agree with me that the work in the delta is not such plain-sailing as might at first appear from the fact that the bulk of the tract is already irrigated.

In fact, the Reservoir scheme embraces several smaller schemes for extensions of irrigation in the delta, and each has its own peculiarities and its own doubtful points to be considered, before it can be predicted that the ryots will take the water.

It will be remembered also the work is scattered all over the delta tracts of two districts and that almost every item of the work specified in paragraphs 6 and 7 lies at a distance from the other items.

9. According to my present calculations, I cannot get through the personal inspection and enquiries involved sooner than about the 10th August. I may add that the Kolair lake is almost inaccessible in most parts till late in July.

If the Board agrees with me that the items above specified require my personal investigation, it will, I hope, accept my assurance that the time allowed me is insufficient, and recommend an extension of my special duty up to the end of August next. This would leave twenty days for unforeseen work and for writing my report. This is quite apart from any extension that may be required for the investigation at the dam site, with which I deal in the succeeding paragraph.

10. At present it is uncertain whether the project will involve the construction of a reservoir at Muktiala, or an anicut at the same spot, or no works at all at that site or near to it.

I do not know whether any decision will be come to in time for myself or my establishment to do any work at this site.

I incline to think that it would be better, in view of this uncertainty, to definitely exclude all question of the amount of compensation due to submersion from the scope of my work.

Should, however, it be decided within the next few weeks that some works will be constructed on this site and that the work must be done before the expiry of my special duty, I must ask for an extension up to the middle or end of September, unless Government thinks that the work may be entrusted entirely to a Tahsildar.

So far as I know, the area submerged by the reservoir will be about 110 to 125 square miles and the anicut, if substituted, will submerge about half as much. Some villages will be submerged in either case, but not big ones.

The site on both sides of the river is troublesome to reach and requires a separate journey on the Kistna and Guntúr sides respectively, the Kistna being impassable at this season. For this reason the work would take the best part of a month.

I also think that an official of Hyderabad should meet me or the Special Tahsildar when working in the Hyderabad territory, more particularly as the submergence of villages is involved. By the time any decision is arrived at regarding the engineering work to be constructed, it will probably be too late to arrange this with the Nizam's Government, even if the inspection were postponed till August next.

On all these grounds I recommend that this portion of the investigation be postponed.

A rough estimate of probable compensation could probably be made from data supplied by other projects, accurate enough for inclusion in the provisional estimates of cost.

11. In conclusion, I would ask that the Board may obtain the orders of Government urgently on the recommendation made in paragraphs 9 and 10 above.

If Government should not be pleased to sanction any extension, I ought to decide at once what portions of this personal work described above can best be omitted.

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*Letter*—from J. M. TURING, Esq., I.C.S., Special Revenue Officer, Kistna Reservoir Project, Guntúr.
*To*—the Secretary to the Commissioner of Revenue Settlement, Survey, Land Records and Agriculture.
*Dated*—Camp Vetapalem, the 4th June 1909.
*No.*—R.C. 100.

Referring to Memorandum from the Chief Engineer for Irrigation, R.C. No. 218-1, dated 22nd May 1909, communicated with Board's Proceedings, Mis. No. 1770, dated 25th May 1909, I have the honour to submit, for the orders of the Board, a brief explanation of the work which has still to be done in the upland portion of the Reservoir scheme.

My reason for addressing the Board in the matter is that little remains to be done except office work, and that this is already nearly half done and may as well be completed.

2. The Board may remember that in his report on the original Kistna Reservoir Project, Mr. Braidwood made deductions from the irrigable area on six main grounds which are detailed in paragraph 3 of Board's Proceedings, No. 210, dated 14th July 1905 (pages 148, 149 of the printed report).

The Board approved four of these six reasons and held that the remaining two were unsound. These two reasons for exclusion which did not commend themselves to the Board, were item (iii) lands situated round bases of hills or on high levels and item (v) lands consisting of pure sand or gravel.

The Board, however, though it disapproved of deductions on these two grounds, generally approved Mr. Braidwood's recommendations, stating that in its opinion an estimate of two-thirds of the total area as irrigable extent was not too low (page 149 of report, closing words of paragraph 3).

Besides the above deductions, Mr. Braidwood recommended a further exclusion of 10 per cent. of the total area on various grounds detailed in paragraph 4 of the Board's Proceedings, and arrived at the same conclusion from a consideration of the needs of pasturage in the tract concerned.

The Board reduced this deduction to 5 per cent. (page 152 of report, closing sentence of paragraph 5).

On the whole, therefore, the Board treated $61\frac{2}{3}$ per cent. of the total area commanded as irrigable, or 1,530,000 acres out of 2,419,000 commanded.

3. I find the records of Mr. Braidwood's investigation, which practically covered the whole upland portion of the present project, go into great detail and are, with few exceptions, complete.

They contain a record of the actual survey numbers included in the irrigable extent, or excluded as unirrigable, and in the case of the latter, the reason why the land is excluded, is clearly stated as a rule.

4. My establishment has checked the lands held to be unirrigable in the case of two taluks and is now checking a third.

These lands have been classified under the following heads according to the grounds of their exclusion:—

(1) Village and house site and lands adjoining village-site and temple porambokes.
(2) Donka, polimara, boundary and railway porambokes.
(3) Vagus and streams.
(4) Burial-ground, wells, straw yards, other miscellaneous communal porambokes.
(5) Tank beds.
(6) Grazing ground.
(7) Topes and forest reserves.
(8) Lands in river or washed away by river.
(9) Lanka lands, lands on river margins cut off or surrounded by vagus.
(10) Lands specifically noted as liable to submersion.
(11) Lands required for river embankment.
(12) High land, land round bases of hills.
(13) Not commanded by project.
(14) Unsuitable soils.

5. The result of this check has been to establish that of the reasons referred to in paragraph 3 of Board's Proceedings, No. 210-D., dated 14th July 1905, reason No. (iii) (high level lands) accounts for a very large fraction of the total deductions, something over 30 per cent. in the case of both taluks already checked.

As anticipated by the Board in discussing that reason, it is now almost certain that it was incorrect. Mr. Braidwood had not the advantage, which I shall have, of being able to refer these high level lands to the Executive Engineer on Special duty for check with actual levels and contours.

That information was not available at the time when Mr. Braidwood completed his special duty.

A check of several villages has already been made by the Executive Engineer, and the result has so far been invariably that there is nothing whatever in the levels to prevent irrigation.

6. Had the Board in 1905 been aware of the facts above stated, I do not think it would have accepted so low a percentage as two-thirds as the maximum irrigable area apart from deductions for grazing.

I anticipate that by the inclusion of these "high lands" alone, the area irrigable will be raised from $61\frac{2}{3}$ per cent. to over 70 per cent.

It is also possible that some material portion of the area excluded as submersible, lanka lands and lands on river margins and lands not commanded, according to Mr. Braidwood's records, will prove to be irrigable when tested with the actual levels.

7. The above check will of course be of no present value, should it be decided that no upland canal at all is to be constructed, though it would be useful if at any future time some other scheme for the irrigation of this tract should be considered.

If, however, it should be decided to retain an upland canal as part of the scheme pending further investigation, or should the retention of an upland canal be dependent on the amount of revenue obtainable, the work I have described is of course essential, is in fact an absolutely necessary preliminary to any discussion of the remunerative aspect of this part of the project.

I think, therefore, it had better go on in spite of the doubt whether the information may ultimately be used or not.

8. It is costing Government nothing at present except the pay of two clerks whom I should not otherwise have entertained, and of course in no way interferes with the delta field work which is now well under way.

I request that the Board may be pleased to obtain the orders of Government permitting me to continue this work on the lines indicated above.

I have been in correspondence with the Superintending Engineer on Special duty on the subject and he agrees with me that the work should proceed.

9. I request orders on one small point connected with the two clerks above mentioned. In accordance with the direction contained in G.O., No. 166, dated 15th April 1909, that I should entertain no more of the establishment than is absolutely needed, I have so far entertained only two Tahsildars out of three, and six Revenue Inspectors out of nine sanctioned. But in addition to the clerical establishment allowed for myself and two Tahsildars, I have entertained, to work in my own office, the two clerks sanctioned to work under the third Tahsildar, as my own clerks cannot cope with the classifying work described above.

I presume that I have power to entertain any part of the sanctioned establishment, but as the order says "two clerks to work under the Tahsildar," I request formal approval of my action in view of possible account objections (I have entertained two clerks on Rs. 20 instead of one on Rs. 30, and one on Rs. 20, not requiring a clerk on Rs. 30, for this mechanical work).

10. On one further point I would ask for orders. I have alluded above in paragraph 3 to some items for which information is not available. For fifteen villages, Mr. Braidwood's detailed records are not forthcoming, having presumably been mislaid in two cases, while the other thirteen villages do not seem to have been investigated.

These villages will take a Revenue Inspector about a month to six weeks to check. Until the receipt of the Board's Proceedings under reference, I proposed to entertain an extra Revenue Inspector for this purpose, and still think this worth doing in order that the work may be complete. I request the Board's orders whether this should be done or not. Orders upon this point should reach me at a very early date in order that the Revenue Inspector's field work may be completed in time for inclusion in my report.

This involves of course no excess of establishment over that already sanctioned, but I am not prepared without orders to entertain extra hands for work which the Board has directed to be deferred for the present.

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*Reference—No.* 1323, *dated* 11*th June* 1909.

Forwarded to the Chief Engineer for Irrigation for favour of very early remarks.

2. The Board will deal with paragraphs 9 and 10 of Mr. Turing's second letter on receipt of the Chief Engineer's reply.

L. D. SWAMIKANNU,
*Secretary.*

To the Chief Engineer for Irrigation,
with two letters in original to be returned with reply.

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## VI

### Note by the Chief Engineer for Irrigation, dated 23rd June 1909.

Submitted for the orders of Government.

2. Under the sanction in G.O., No. 166 I., dated 15th April 1909, Mr. Turing's special duty extends up to 4th August 1909. In paragraphs 1 to 9 of his letter R.C. No. 127, dated 4th June 1909, he has made out a strong case for extending the period of his special duty up to 31st August. As orders have since been issued directing Mr. Turing to deal with the question of waste lands to be reserved for grazing and communal purposes under the upland canal and as he may have to inspect some of the lands himself, the undersigned considers that the extension up to end of August is inadequate and recommends that the period may be extended to the end of October 1909.

3. The question of fixing the amount of compensation to be paid for the area to be submerged by the reservoir may, as proposed in paragraph 10 of Mr. Turing's letter, R.C. No. 127, dated 4th June 1909, be postponed for the present.

4. In the circumstances reported by Mr. Turing in paragraphs 1—8 of his letter R.C. No. 100, dated 4th June 1909, he may be permitted to proceed with the investigation of the upland canal area also along with the investigation of extensions in the Kistna delta.

5. Under G.O., No. 483, Financial, dated 10th October 1908, the Board of Revenue may deal with paragraphs 9 and 10 of Mr. Turing's letter R.C. No. 100, dated 4th June 1909, regarding variations in the sanctioned scale of establishment.

C. A. SMITH,
*Chief Engineer for Irrigation.*

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**Order—No. 273 I., dated 28th June 1909.**

The recommendations of the Chief Engineer for Irrigation are approved and the period of appointment of the special revenue establishment sanctioned in G.O., No. 166 I., dated 15th April 1909, will be extended to the end of October 1909.

2. Orders regarding the extension to the end of October 1909 of Mr. Turing's deputation sanctioned in G.O., No. 276, Public, dated 24th April 1909, will issue in the Public Department.

(True Extract.)

C. A. SMITH,
*Joint Secretary to Government, P.W.D.,*
*Irrigation Branch.*

To the Chief Engineer for Irrigation.
,, Superintending Engineer on Special duty.
,, Superintending Engineer, II Circle.
,, Board of Revenue (Revenue Settlement).
,, Revenue Department.
,, Public Department (with notes).
,, Examiner, Public Works Accounts.

# Government of Madras.

PUBLIC WORKS DEPARTMENT.

IRRIGATION.

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## G.O., No. 274 I., 28th June 1909.

Periyar Power scheme.

Submitting to the Government of India the — as described by Mr. Chatterton in his letter No. 74-G., dated 27th March 1909, and requesting their approval to its being proceeded with in detail.

GOVERNMENT OF MADRAS.

# PUBLIC WORKS DEPARTMENT.

## Irrigation.

Read—the following papers:—

I

### G.O., Nos. 1020-21 I., dated 28th October 1905.

Abstract.—Ordering that a letter be sent to the Government of India submitting, with remarks, proposals for the development of power by Periyár water drawn up in conformity with the views of that Government.

II

### G.O., No. 226 I., dated 17th June 1908.

Abstract.—Passing orders on the report showing the results of the Periyár-Pambiyar investigation and directing that further investigation be deferred, that the gauging of the Pambiyar river be continued and that a copy of the proceedings be forwarded to the Government of India for information.

III

*Letter*—from L. M. Jacob, Esq., c.s.i., Secretary to the Government of India, Public Works Department (Civil Works—Irrigation).
*To*—the Joint Secretary to the Government of Madras, Public Works Department (Irrigation Branch).
*Dated*—Simla, the 4th May 1906.
*No.*—573 I.

In reply to your letter No. 1021 I., dated the 28th October 1905, submitting proposals for the development of power by Periyár water, I am directed to forward herewith copy of a note, dated the 29th March 1906, by the Inspector-General of Irrigation, on the subject, and to say that the Government of India, as at present advised, are not prepared to approve of the project, but are ready to consider any further representations that the Local Government may desire to make.

2. I am to say that as pointed out in this office letter No. 269 C.W.I., dated 16th February 1905, the primary object of the Periyár project is irrigation which is of importance not only in its financial, but also, and even more, in its protective aspect; and that the present proposals sacrifice the latter, since they involve a diversion of water from irrigational to industrial ends in years of short rainfall, that is, in precisely the years in which it is most needed for the purpose of protection.

3. I am also to point out that the opinion of the Board of Revenue upon the proposals was asked for in paragraph 2 of the above quoted letter, but has not been supplied.

4. The extension of irrigation from the Periyár canal system will form the subject of a separate communication.

5. The plans and estimates received with your letter under reply are herewith returned.

Enclosure.

*Note on the proposed Periyár Power Scheme of* 1905 *by Mr. J. Benton, C.I.E., Inspector-General of Irrigation, dated* 29*th March* 1906.

*Surplus water, Periyár reservoir.*—On investigating the surplus supplies of water from the past records for the eight years 1896-97 to 1904-1905, and on taking into account the 2,360 millions cubic feet increase of storage to be got when the new escape regulator is completed, the Chief Engineer came to the following conclusions:—

(i) That there will be averagely 10,000 millions cubic feet of surplus water available from the run-off which would suffice for increase of irrigation by 25,000 acres.

(ii) That the existing reservoir cannot provide storage for an extra 10,000 millions cubic feet, while the existing tunnel has no surplus capacity for extra supply.

(iii) That the cost of providing extra storage on the plains and of enlarging the tunnel would be prohibitive, even as an irrigation protective work.

(iv) That by diminishing the supply for irrigation in years of unfavourable rainfall, it would be possible to provide a constant supply of 500 cusecs for a power scheme of 1,000 feet fall, yielding 33,000 horse power, and that the revenues from this would make the scheme remunerative quite apart from those from extra irrigation.

(v) That we should construct a high level cut through the water shed, to supplement the discharging capacity of the tunnel, and construct a reservoir on the plains near the foot of the hills to store the water sent down for power purposes, until it could be used for irrigation; this proposed new reservoir to be on the natural channel which now conveys the Periyár water to the plains of Madura.

2. *Effect of scheme.*—In order to see how the proposed scheme would answer, the Chief Engineer prepared the tables—Appendix 4 of his note referred to in paragraph 5 of Joint Secretary's letter; these tables are for the eight years which have lapsed from the opening of the work in 1896–97 up to 1904–1905. This was far too short a period to show the worst year which might be expected.

3. *Table for* 1905–1906.—On visiting the Periyár when on tour, I ascertained that in the year 1905–1906 there had been no surplus water whatever; moreover, the reservoir never filled, the highest level attained being 3·5 feet below full tank level; and at the date of my visit the water stood at a lower level than it had ever been since the work came into operation. I have procured the annexed table, prepared in the same manner as Chief Engineer's Appendix 4 and in continuation of the same; as in the case of the preceding years the reservoir has been assumed to be used, so as to give the full amount of power throughout, irrespective of irrigation requirements in the various months. The results are shown in the last column of the table and in other words may be stated to be as follows:—

| Year. | Month. | How far requirements obtainable. | |
|---|---|---|---|
| | | Power scheme. | Irrigation. |
| 1905 | 31st March | Requirements fully met up to 18th June 1906, when, in the absence of rain from now to then, the level would fall to R.L. 122 and the tunnel could no longer draw off 500 cusecs. | No supply required. |
| | April | | Do. |
| | May | | Do. |
| | June | | Full supply obtainable. |
| | July | | Do. |
| | August | | Two-fifths of full supply obtainable. |
| | September | | One-third of do. do. |
| | October | | Nine-tenths of do. do. |
| | November | | Three-fourths of do. do. |
| | December | | Two-fifths of do. do. |
| 1906 | January | | Half of do. do. |
| | February | | Three-fourths of do. do. |
| | March | | No supply required. |
| | April | | Do. |
| | May | | Do. |
| | 18th June | | No supply whatever available although required in June. |

This table shows as follows:—

(*a*) In September, a vital month, two-thirds of the irrigation would have been sacrificed on account of the proposed power supply guarantee.

(*b*) After 18th June if no rain is received from 25th March until that date, both irrigation and power scheme would fail.

4. *The most unfavourable year.*—There is nothing to show that the year 1905–1906 is the most unfavourable which will ever occur; bad as that year was, involving a loss of two-thirds of the irrigation, it is just possible we might get a worse one involving loss of nearly the whole of the irrigation, in order that the water power guarantees might be fulfilled. For half a century or so to come, no one can say what is the worst year which may be expected.

5. *Need for factories and power.*—Kuravanuth at the foot of the Periyár ghât and head of the Cumbum valley is 69 miles from the nearest railway station. I did not see, all told, 200 acres of cotton from the road when proceeding along the valley. There are no great centres of labour in the valley. Kuravanuth is notoriously unhealthy. The proposed railway appears to be still a mere proposal; even if it is made, 69 miles out and the same back would be a long lead, while without a railway no user of power would ever locate a factory in such a place.

Cables to other distant places would be costly.

6. *Guarantee.*—With reference to the Madras Government letter No. 1021 I., dated 28th October 1905, and paragraph 13 of Chief Engineer's note accompanying the same, I wish to remark as follows. No user of power will make any offer without a guarantee of constancy of

supply; Government cannot make any guarantee of this kind. I would invite attention to the report of the Irrigation Commission, Volume II, paragraphs 175 and 176. It will be seen that owing to an ill-considered obligation entered into with the Gokak Mill Company to supply water for the production of power, the result is so serious that the Irrigation Commission suggested as follows:—

"It appears not improbable that it may eventually be advantageous to obtain release from "this obligation by providing the company with engine power for use during the dry season, and "also paying the cost of working; the expenditure thus involved will not be balanced by the "increase in irrigation revenue that will ensue; but the difference would probably be not too high "a sum to pay for the sake of the larger area which will be cultivated and protected."

The Gokak and Periyár power cases are parallel ones, but the former involves a guarantee of only 136 cusecs falling through 180 feet, whilst the latter involves 500 cusecs falling through 1,000 feet, so that compensation in the latter case would be over twenty times what it would be in the former, if the water power was replaced by steam power.

7. *Abandonment of power scheme.*—It is unnecessary to examine any of the details of the scheme, since it breaks down as regards the first necessity, namely—a sufficient water-supply. I unhesitatingly recommend abandonment of the scheme both in its present or any reduced scope. The question may be left over for posterity to consider 50 or 100 years hence, by which time more complete information will be available as to available water-supply.

8. *Requirements of the Periyár scheme.*—This work paid 4 per cent. on the capital cost last year, but it appears to me probable that it can be developed, as an irrigation work, so as to yield a much better return; I will deal with this question in a separate note.

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## IV

From A. Chatterton, Esq., Director of Industries, dated 24th February 1909, No. 74-G.

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## V

*Letter*—from A. Chatterton, Esq., Director of Industries, Madras.
*To*—the Secretary to Government, Revenue Department.
*Dated*—the 27th March 1909.
*No.*—74-G.

In continuation of my No. 74-G. of the 1st March 1909, I have the honour to forward a further note on the proposals for establishing a hydro-electric station for the utilisation of the water power available at the Periyár.

2. The question was discussed with the Inspector-General of Irrigation at a meeting which was held at the Government House, Guindy, on the 15th of March when His Excellency the Governor, Mr. Benton, the Inspector-General of Irrigation, Mr. Wilson, the Chief Engineer, and Mr. Smith, the Chief Engineer for Irrigation, were present. At that discussion, Mr. Benton said he did not think any proposals could be sanctioned, which involved retaining water in the Periyár lake for the purpose of supplying power during the hot weather months. There must be, he said, no restraint placed upon the supply of water for irrigation, but he was prepared to consider a scheme which involved pumping water out of the lake below the level of the watershed cutting, and he suggested that the effect of this should be worked out and submitted to him in detail. This I have done and I now submit the results of the same in a tabular statement attached to the note referred to above.

3. Neither Mr. Benton nor the Chief Engineer for Irrigation accepts my views regarding the value of an absolutely certain perennial supply of water. Time must be allowed for further evidence on this point to accumulate, but, in the meantime, I base the feasibility of my proposals for developing this water power solely on the ground that, if they are carried out, there will be a reasonable return on the capital outlay, and the industries of the Madura district will be greatly benefited by a large supply of cheap power. As will be seen from the note, pumping water from the lake during the hot weather months means that in years of deficient rainfall, there will be some delay in starting irrigation due to the time required to refill the lake to the level at which the necessary supply can be passed down the watershed cutting by gravitation. I would submit that this delay is not a very serious disadvantage, that it will cause little or no loss to the ryots and that generally the slight interference with irrigation may well be

borne to secure the advantages of a cheap supply of power. At the end of the irrigation season, the provision for pumping water from the lake, after it has ceased to discharge naturally, is a distinct advantage to the irrigation, inasmuch as it enables a certain supply of water to be sent down which would otherwise have remained unutilized in the lake.

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ENCLOSURES.

## NOTE.

From the Chief Engineer for Irrigation, I have received the following data. The normal requirements for irrigation are—

2,500 millions cubic feet of water per month in June and July.
3,000 " " in August.
3,160 " " in September, October, November, December and January.
1,850 " " in February.

From the 1st of March to the 1st of June, water is not required for the irrigation of the lands under the Periyár Project.

2. Printed tables giving the capacity of the Periyár lake at various levels have been furnished to me and from these data I have endeavoured to ascertain what would have been the condition of the Periyár lake at any time since the 1st of August 1896 to the 1st of April 1908, assuming that the normal requirements of the irrigation were passed off through the tunnel and that during the whole period a minimum supply of 400 millions cubic feet a month was maintained for the generation of power. The water passes from the reservoir to the tunnel of the watershed through a cutting, the highest level of which I have taken to be 108. The bottom width of this cutting is 35 feet and the sides are vertical. With 10 feet depth of water in the cutting, I calculate the discharge will be 1,245 cubic feet per second or slightly above that required to maintain the full supply of 3,160 millions cubic feet per month. With 4 feet depth of water in the cutting, I calculate that the discharge would be 315 cusecs or slightly more than 400 millions cubic feet a month assuming that the water is only allowed to flow for twelve hours a day. Till the water in the lake falls to the level of 112, the power scheme will in no way interfere with the supply of water for irrigation, but after it has reached that level, I have assumed that water will only be discharged from the lake for twelve hours a day and that the quantity will not exceed 400 millions cubic feet per month; that is to say, when the natural discharge through the watershed cutting falls below 800 millions cubic feet per month, half the supply will be cut off and pumping started. This means that for about a week the discharge through the tunnel would be slightly less than what would have been the case if the water had been allowed to flow freely both day and night, but there would, however, be no difficulty in arranging to supply water by pumping during the day time and the small natural flow during night, in which case the irrigation would be slightly better off as the result of pumping, than would otherwise have been the case.

3. From the diagrams showing the level of the water in the Periyár lake from 1896 to 1908 the curves shown on sheet 3 have been prepared, and the data are given in tabular form at the end of this note. On the 1st of August 1896, it was assumed that the lake was full of water at the level 152 and from that date onwards the levels of each month have been determined by the addition of the water which actually came into the lake during the month and by the subtraction of the water, not as it was actually withdrawn for irrigation, but according to the normal demand already mentioned. Whenever the lake reached full supply level, any further addition during the month is assumed to have been surplussed. From the 1st of August 1896 to the 14th January 1899, the power scheme would have had no effect upon the lake, as there was an abundant supply of water. From the 14th of January to the end of the month, the lake would have emptied itself through the watershed cutting and would have fallen to the level of 112 on the 1st of February. Thence onwards pumping would be necessary and would continue till the end of April when the water-level would have fallen to 108·2 and the maximum lift against the pumps would be less than 4 feet. The rains of April filled the lake up again to the level of 122 and it would have been possible to have given full supply for irrigation at the beginning of June. In 1900, the full supply would cease on the 11th of January and pumping would have to be started on the 28th of that month and would continue till the 10th of June, the maximum lift against the pumps being about 7 feet. Up to this point the power supply scheme would have involved no interference whatever with the irrigation, and it would have contributed 400 millions cubic feet a month all through the hot weather. In 1900, however, it would not have been possible to start irrigation till the 16th of June, whilst if there had been no pumping, irrigation might have started some ten days earlier. Thence onward till February 1905, the normal irrigation demand would have been supplied without difficulty. On the 23rd February, however, the lake would have fallen to the level of 112 and pumping would have had to be started. The deficiency of water-supply in February would have been 270 millions cubic feet. Without pumping, water could have been let down on the 1st of June, but the lowering of the lake due to this cause would have delayed the opening of the irrigation season till the 15th of June. Thence onward to the end of the season, which proved to be a very bad one, the power scheme would have no effect upon the water-supply. On the 1st January 1906,

pumping would have commenced and continued to the 1st of July, or for a period of six months, during which time the level in the lake would be lowered to 101·7 and the pumps would have had to lift the water to a maximum height of 11 feet. Not till the 20th July would it have been possible to give a full supply to irrigation. The water-supply in June would have been restricted to 400 millions cubic feet and the water-supply in July to 1,283 millions cubic feet. This is the most serious interference with the irrigation during the whole period of twelve years for which data are available. In 1907, pumping would have been started on the 15th of February and would have ceased on the 21st June. June would get a short supply, but thence onward till the 1st April 1908 there would be an ample supply of water for irrigation. The effect of pumping may perhaps be best summarised by stating the deficiency in the lake which would have to be made good on the 1st of June, before a full supply could be delivered. This is shown in the following tabular statement:—

| | |
|---|---|
| 1897 ... ... ... ... ... ... ... | ... |
| 1898 ... ... ... ... ... ... ... | ... |
| 1899 ... ... ... ... ... ... ... | ... |
| 1900 ... ... ... ... ... ... ... | 2,095 millions cubic feet. |
| 1901 ... ... ... ... ... ... ... | ... |
| 1902 ... ... ... ... ... ... ... | ... |
| 1903 ... ... ... ... ... ... ... | ... |
| 1904 ... ... ... ... ... ... ... | ... |
| 1905 ... ... ... ... ... ... ... | 1,597 millions cubic feet. |
| 1906 ... ... ... ... ... ... ... | 2,413 ,, |
| 1907 ... ... ... ... ... ... ... | 1,570 ,, |
| 1908 ... ... ... ... ... ... ... | ... |

From this it will be seen that only in four years out of twelve has any deficiency to be made good: but it is not so much the volume of the deficiency as the character of the early rainfall in June and July, which determines the effect upon irrigation. A large deficiency may be made good by a few days' heavy rainfall early in June, or a comparatively small deficiency may be prolonged into July by a late and feeble monsoon. The worst year hitherto experienced was 1906 when a large deficiency was combined with a late monsoon. In this year the power scheme would have seriously inconvenienced irrigation and the area under cultivation would probably have been restricted. There would have been sufficient water to have grown the first crop over the whole area, but it would have been a late crop and the second crop would probably have suffered owing to the lateness of the season and the limited supply of water visible in the lake throughout the year.

4. The diagrams show that the area drained by the Periyár river is insufficient to fully utilize the storage capacity created behind the Periyár dam. For a period of 34 months, the lake never surplussed at all, and in many years the quantity which will be surplussed under the new conditions is extremely small. It has been proposed to divert the Pambar river into the Periyár basin either with or without the creation of a large storage reservoir on the Pambar itself. Mr. Tressler, my Assistant, was employed on the preliminary surveys, and he points out that at a very small cost, part of the proposed scheme might be carried out by diverting the waters of the Kullar river into the Periyár basin. This would involve the construction of a small masonry dam and a comparatively shallow cutting through the watershed between the Periyár and the Kullar. In an appendix Mr. Tressler has explained what can be done and it seems to me that it will be quite practicable to build the dam across the Kullar completely closing it and to pass the waters coming down the river through a cutting in the watershed ridge sufficiently wide to carry off the maximum discharge of the Kullar. I think it may be accepted that this small diversion scheme which apparently can be carried out for about 1 lakh of rupees, would have added 2,500 millions cubic feet of water to the Periyár lake between October 1904 and August 1907. In ordinary years, such a contribution would be of no material value, but in years of deficient supply, it would be of great assistance. If this diversion is made at the cost of the power scheme, it would, I think, be a good deal more than a fair *quid pro quo* for the interference with irrigation which the power scheme would sometimes entail.

5. In this note I do not propose to deal in detail with the prospects of the hydro-electric scheme from a financial point of view. Providing for a pumping plant to be used in the watershed cutting and for the delivery of 20,000 horse power in Madura by a duplicated transmission line, the cost of the work will probably not exceed 65 lakhs of rupees, against which a total gross revenue of Rupees 13,75,000 might ultimately be expected. Assuming that the working expenses amount to as much as 10 per cent. on the gross cost of the works, there will be a balance of 7¼ lakhs of rupees from which a sinking fund can be provided and a substantial balance left as net revenue on the undertaking. At the outset it would be undesirable to instal a plant to deliver more than 10,000 horse power in Madura. This would interfere much less with irrigation than the proposal to supply 20,000 horse power and it would give time for further consideration of various schemes for supplementing the water-supply to the Periyár Project. With the 20,000 horse power fully developed and utilized in Madura, a very substantial contribution could be made towards the cost of improving the supply of water in the Periyár lake and this would probably justify the carrying out of the Pambar diversion, which, without power, would hardly be profitable.

*27th March 1909.*

A. Chatterton,
*Director of Industries.*

*Data.*

Crest of watershed cutting (107·93) 108.

Bed fall, 1 foot per mile.

Bottom width of cutting, 35 feet.

Sides, vertical.

Maximum discharge, 3,160 millions cubic feet per month.

Daily discharge, 105,333,000 cubic feet.

Cubic feet per second, 1,220.

$$\text{Discharge} = C\,A\,\sqrt{rs}$$

S = Slope of cutting. .. $\sqrt{S} = \cdot0138$

A = Area .. $A = 35\,d$

r = H.M.D. .. $r = \dfrac{35\,d}{2d + 35}$

$$C = \frac{46\cdot1 + \dfrac{1\cdot811}{N} + \dfrac{\cdot00281}{S}}{1 + \left(41\cdot6 + \dfrac{\cdot00281}{S}\right)\dfrac{N}{\sqrt{r}}}$$

Co-efficient in Kutter's formula. $N = 0\cdot020$

$S = \cdot0001895$

$$= \frac{41\cdot6 + \dfrac{1\cdot811}{0\cdot020} + \dfrac{\cdot00281}{\cdot0001895}}{1 + \left\{41\cdot6 + \dfrac{\cdot00281}{\cdot0001895}\right\}\dfrac{0\cdot020}{\sqrt{r}}}$$

$$= \frac{41\cdot6 + 95\cdot5 + 14\cdot83}{1 + (41\cdot6 + 14\cdot83)\dfrac{0\cdot020}{\sqrt{r}}}$$

When $r = 1$ .. .. $C = \dfrac{151\cdot9}{1 + (56\cdot43)\,\cdot020} = \dfrac{151\cdot9}{2\,1286}$

As corrected in the Chief Engineer's office.

$$\frac{41\cdot6 + \dfrac{1\cdot811}{0\cdot020} + \dfrac{\cdot00281}{\cdot0001894}}{1 + \left\{41\cdot6 + \dfrac{\cdot00281}{\cdot0001894}\right\}\dfrac{0\cdot020}{\sqrt{r}}}$$

$$\frac{41\cdot6 + 90\cdot55 + 14\cdot83}{1 + (41\cdot6 + 14\cdot83)\dfrac{0\cdot020}{\sqrt{r}}}$$

$$= \frac{146\cdot98}{1 + (56\cdot43)\,\cdot020} = \frac{146\cdot98}{2\cdot1286}$$

| r | C | C (as corrected in the Chief Engineer's office) |
|---|---|---|
| 1 | = 73·5 | = 69·05 |
| 2 | = 84·5 | = 81·74 |
| 3 | = 91·9 | = 88·99 |
| 4 | = 97·1 | = 93·96 |
| 5 | = 101·1 | = 97·67 |
| 6 | = 104·0 | = 100·62 |
| 7 | = 106·4 | = 103·03 |
| 8 | = 108·5 | = 105·06 |
| 9 | = 110·3 | = 106·80 |

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## *Discharge of Watershed Cutting.*

As corrected in the Chief Engineer's office.

| When D = | R | $\sqrt{r}$ | R (as corrected) | $\sqrt{r}$ (as corrected) |
|---|---|---|---|---|
| 3 | 2·56 | 1·60 | 2·56 | 1·60 |
| 4 | 3·18 | 1·78 | 3·25 | 1·80 |
| 5 | 3·89 | 1·97 | 3·89 | 1·97 |
| 6 | 4·43 | 2·11 | 4·47 | 2·11 |
| 7 | 5 | 2·24 | 5·00 | 2·24 |
| 8 | 5·49 | 2·34 | 5·49 | 2·34 |
| 9 | 5·94 | 2·44 | 5·94 | 2·44 |
| 10 | 6·37 | 2·53 | 6·37 | 2·53 |
| 11 | 6·76 | 2·60 | 6·76 | 2·60 |
| 12 | 7·12 | 2·67 | 7·1 | 2·67 |

From curve Discharge. $C\,A\,\sqrt{rs}$

| D = | C | C (as corrected) |
|---|---|---|
| 3 | 89·5 | 86·46 |
| 4 | 92·9 | 90·60 |
| 5 | 96·5 | 93·70 |
| 6 | 98·9 | 96·01 |
| 7 | 101·1 | 97·98 |
| 8 | 102·5 | 99·40 |
| 9 | 103·8 | 100·74 |
| 10 | 104·9 | 101·88 |
| 11 | 105·9 | 102·73 |
| 12 | 106·7 | 103·55 |

| With ft. depth in | D | cusecs. | D (as corrected) | cusecs. |
|---|---|---|---|---|
| 3 | 89·5 × 105 × 1·6 × 0·0138 = | 213 | 86·46 × 105 × 1·6 × 0·0138 = | 200 |
| 4 | 92·9 × 140 × 1·78 × 0·0138 = | 318 | 90·60 × 140 × 1·8 × 0·0138 = | 315 |
| 5 | 96·5 × 175 × 1·97 × 0·0138 = | 459 | 93·70 × 175 × 1·97 × 0·0138 = | 446 |
| 6 | 98·9 × 210 × 2·11 × 0·0138 = | 605 | 96·01 × 210 × 2·11 × 0·0138 = | 585 |
| 7 | 101·1 × 245 × 2·24 × 0·0138 = | 766 | 97·98 × 245 × 2·24 × 0·0138 = | 742 |
| 8 | 102·5 × 280 × 2·34 × 0·0138 = | 926 | 99·40 × 280 × 2·34 × 0·0138 = | 902 |
| 9 | 103·8 × 315 × 2·44 × 0·0138 = | 1,100 | 100·74 × 315 × 2·44 × 0·0138 = | 1,069 |
| 10 | 104·9 × 350 × 2·53 × 0·0138 = | 1,282 | 101·88 × 350 × 2·53 × 0·0138 = | 1,245 |

*Time required to empty the lake through the watershed cutting assuming no inflow to the lake.*

| Level. | Capacity. | Difference. | Water level lowered in days. | Water level lowered in days (column 4) as corrected in the Chief Engineer's office. |
|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 |
| 109 .. .. .. .. .. .. .. .. | 5,847 | | | |
| | | 156 | .. | .. |
| 110 .. .. .. .. .. .. .. .. | 6,003 | | | |
| | | 160 | .. | .. |
| 111 .. .. .. .. .. .. .. .. | 6,163 | | | |
| | | 161 | 6·950 | 7·235 |
| 112 .. .. .. .. .. .. .. .. | 6,324 | | | |
| | | 160 | 4·740 | 4·866 |
| 113 .. .. .. .. .. .. .. .. | 6,484 | | | |
| | | 168 | 3·658 | 3·771 |
| 114 .. .. .. .. .. .. .. .. | 6,652 | | | |
| | | 167 | 2·820 | 2·912 |
| 115 .. .. .. .. .. .. .. .. | 6,819 | | | |
| | | 180 | 2·462 | 2·534 |
| 116 .. .. .. .. .. .. .. .. | 6,999 | | | |
| | | 180 | 1·895 | 2·113 |
| 117 .. .. .. .. .. .. .. .. | 7,179 | | | |
| | | 180 | 1·750 | 1·800 |
| 118 .. .. .. .. .. .. .. .. | 7,359 | | | |
| Total .. | .. | 1,512 | 24·275 to 111<br>17·325 to 112 | 25·231 to 111<br>17·996 to 112 |

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*Daily discharges of watershed cutting at various depths.*

| Depth in feet. | Discharge in millions of cubic feet per day. | Average. | Water level. | As corrected in the Chief Engineer's office. Discharge in millions of cubic feet per day (col. 2.) | Average (col. 3). | Water level (col. 4). |
|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 3 .. .. .. .. .. .. | 18·4 | | 111 | 17·28 | | 111 |
| | | 23·15 | | | 22·25 | |
| 4 .. .. .. .. .. .. | 27·9 | | 112 | 27·22 | | 112 |
| | | 33·75 | | | 32·88 | |
| 5 .. .. .. .. .. .. | 39·6 | | 113 | 38·53 | | 113 |
| | | 45·95 | | | 44·54 | |
| 6 .. .. .. .. .. .. | 52·3 | | 114 | 50·54 | | 114 |
| | | 59·25 | | | 57·33 | |
| 7 .. .. .. .. .. .. | 66·2 | | 115 | 64·11 | | 115 |
| | | 73·10 | | | 71·02 | |
| 8 .. .. .. .. .. .. | 80·0 | | 116 | 77·93 | | 116 |
| | | 87·50 | | | 85·15 | |
| 9 .. .. .. .. .. .. | 95·0 | | 117 | 92·36 | | 117 |
| | | 102·90 | | | 99·97 | |
| 10 .. .. .. .. .. .. | 110·8 | | 118 | 107·57 | | 118 |

The lake runs off through the watershed cutting from a level of 118 to 112 in 17·325 days.

The lake runs off through the watershed cutting from a level of 118 to 112 in 17·99 days.

*Levels at which water would have been maintained in the lake under the conditions detailed in the Note.*

| Date. | Water level. | Contents of lake. | Addition during month. | Discharge during month. |
|---|---|---|---|---|
| 1st August lake surplussed. | | | | |
| *1896.* | | | | |
| 1st August .. .. .. .. .. .. .. | 152 | 15,662 | 5,851 | 3,000 |
| 1st September .. .. .. .. .. .. .. | 152 | 15,662 | 1,349 | 3,160 |
| 1st October .. .. .. .. .. .. .. | 146 | 13,851 | 3,452 | 3,160 |
| 1st November .. .. .. .. .. .. .. | 147 | 14,143 | 7,720 | 3,160 |
| 1st December .. .. .. .. .. .. .. | 152 | 15,662 | 3,932 | 3,160 |
| *1897.* | | | | |
| 1st January .. .. .. .. .. .. .. | 152 | 15,662 | 736 | 3,160 |
| 1st February .. .. .. .. .. .. .. | 144 | 13,238 | 756 | 1,850 |
| 1st March .. .. .. .. .. .. .. | 139 | 12,144 | 487 | 400 |
| 1st April .. .. .. .. .. .. .. | 140 | 12,231 | 370 | 400 |
| 1st May .. .. .. .. .. .. .. | 140 | 12,201 | 162 | 400 |
| 1st June .. .. .. .. .. .. .. | 139 | 11,963 | 8,204 | 2,500 |
| 1st July .. .. .. .. .. .. .. | 152 | 15,662 | 6,292 | 2,500 |
| 1st August .. .. .. .. .. .. .. | 152 | 15,662 | 9,974 | 3,000 |
| 1st September .. .. .. .. .. .. .. | 152 | 15,662 | 2,047 | 3,160 |
| 1st October .. .. .. .. .. .. .. | 148 | 14,549 | 2,479 | 3,160 |
| 1st November .. .. .. .. .. .. .. | 146 | 13,868 | 4,268 | 3,160 |
| 1st December .. .. .. .. .. .. .. | 150 | 14,976 | 977 | 3,160 |
| *1898.* | | | | |
| 1st January .. .. .. .. .. .. .. | 142 | 12,793 | 611 | 3,160 |
| 1st February .. .. .. .. .. .. .. | 132 | 10,244 | 901 | 1,850 |
| 1st March .. .. .. .. .. .. .. | 127 | 9,295 | 188 | 400 |
| 1st April .. .. .. .. .. .. .. | 126 | 9,083 | 118 | 400 |
| 1st May .. .. .. .. .. .. .. | 125 | 8,801 | 373 | 400 |
| 1st June .. .. .. .. .. .. .. | 125 | 8,774 | 2,937 | 2,500 |
| 1st July .. .. .. .. .. .. .. | 127 | 9,211 | 3,984 | 2,500 |
| 1st August .. .. .. .. .. .. .. | 134 | 10,595 | 1,263 | 3,060 |
| 1st September .. .. .. .. .. .. .. | 126 | 8,958 | 1,059 | 3,160 |
| 1st October .. .. .. .. .. .. .. | 115 | 6,867 | 5,120 | 3,160 |
| 1st November .. .. .. .. .. .. .. | 125 | 8,817 | 3,728 | 3,160 |
| 1st December .. .. .. .. .. .. .. | 128 | 9,385 | 1,719 | 3,160 |
| *1899.* | | | | |
| 1st January .. .. .. .. .. .. .. | 121 | 7,944 | 800 | 2,430 |
| Full supply ceases 14th January. | | | | |
| 1st February .. .. .. .. .. .. .. | 112 | 6,324 | 158 | 400 |
| Pumping commences. | | | | |
| 1st March .. .. .. .. .. .. .. | 110·5 | 6,082 | 49 | 400 |
| 1st April .. .. .. .. .. .. .. | 108·2 | 5,731 | 2,945 | 400 |
| Pumping ceases at the end of April. | | | | |
| 1st May .. .. .. .. .. .. .. | 122 | 8,276 | 482 | 400 |
| 1st June .. .. .. .. .. .. .. | 123 | 8,358 | 4,300 | 2,500 |
| 1st July .. .. .. .. .. .. .. | 131 | 10,158 | 8,207 | 2,500 |
| 1st August .. .. .. .. .. .. .. | 152 | 15,662 | 1,128 | 3,000 |
| 1st September .. .. .. .. .. .. .. | 145 | 13,790 | 742 | 3,160 |
| 1st October .. .. .. .. .. .. .. | 137 | 11,372 | 3,518 | 3,160 |
| 1st November .. .. .. .. .. .. .. | 138 | 11,730 | 1,471 | 3,160 |
| 1st December .. .. .. .. .. .. .. | 131 | 10,041 | 1,467 | 3,160 |
| *1900.* | | | | |
| 1st January .. .. .. .. .. .. .. | 123 | 8,348 | 212 | 2,127 |
| Full supply ceases 11th January. | | | | |
| Pumping commences 28th January. | | | | |
| 1st February .. .. .. .. .. .. .. | 111·6 | 6,271 | 50 | 400 |
| 1st March .. .. .. .. .. .. .. | 109·5 | 5,921 | 20 | 400 |
| 1st April .. .. .. .. .. .. .. | 107 | 5,541 | 187 | 400 |
| 1st May .. .. .. .. .. .. .. | 105·7 | 5,328 | 346 | 400 |
| 1st June .. .. .. .. .. .. .. | 105·2 | 5,264 | 3,159 | 1,450 |
| Pumping ceases 10th June. | | | | |
| Water let down 16th June. | | | | |
| 1st July .. .. .. .. .. .. .. | 121 | 7,973 | 9,325 | 2,500 |
| 1st August .. .. .. .. .. .. .. | 149 | 14,798 | 13,002 | 3,000 |
| 1st September .. .. .. .. .. .. .. | 152 | 15,662 | 2,448 | 3,160 |
| 1st October .. .. .. .. .. .. .. | 150 | 14,950 | 2,589 | 3,160 |
| 1st November .. .. .. .. .. .. .. | 148 | 14,379 | 3,922 | 3,160 |
| 1st December .. .. .. .. .. .. .. | 150 | 15,141 | 1,702 | 3,160 |

Levels at which water would have been maintained in the lake under the conditions, etc.—*cont.*

| Date. | Water level. | Contents of lake. | Addition during month. | Discharge during month. |
|---|---|---|---|---|
| *1901.* | | | | |
| 1st January | 145 | 13,683 | 1,220 | 3,160 |
| 1st February | 138 | 11,743 | 493 | 1,850 |
| 1st March | 133 | 10,386 | 1,232 | 400 |
| 1st April | 136 | 11,218 | 540 | 400 |
| 1st May | 137 | 11,358 | 188 | 400 |
| 1st June | 135 | 11,146 | 4,080 | 2,500 |
| 1st July | 142 | 12,726 | 7,666 | 2,500 |
| 1st August | 152 | 15,662 | 3,257 | 3,000 |
| 1st September | 152 | 15,662 | 1,219 | 3,160 |
| 1st October | 146 | 13,721 | 2,591 | 3,160 |
| 1st November | 143 | 13,152 | 6,036 | 3,160 |
| 1st December | 152 | 15,662 | 1,450 | 3,160 |
| *1902.* | | | | |
| 1st January | 146 | 13,952 | 2,467 | 3,160 |
| 1st February | 144 | 13,259 | 264 | 1,850 |
| 1st March | 138 | 11,673 | 22 | 400 |
| 1st April | 136 | 11,295 | 151 | 400 |
| 1st May | 135 | 11,046 | 75 | 400 |
| 1st June | 134 | 10,721 | 58 | 2,500 |
| 1st July | 123 | 8,279 | 5,814 | 2,500 |
| 1st August | 137 | 11,593 | 1,591 | 3,000 |
| 1st September | 131 | 10,184 | 3,324 | 3,160 |
| 1st October | 132 | 10,348 | 8,323 | 3,160 |
| 1st November | 152 | 15,511 | 7,461 | 3,160 |
| 1st December | 152 | 15,662 | 6,872 | 3,160 |
| *1903.* | | | | |
| 1st January | 152 | 15,663 | 551 | 3,160 |
| 1st February | 143 | 13,053 | 153 | 1,850 |
| 1st March | 138 | 11,356 | 16 | 400 |
| 1st April | 135 | 10,956 | 23 | 400 |
| 1st May | 133 | 10,579 | 280 | 400 |
| 1st June | 133 | 10,459 | 682 | 2,500 |
| 1st July | 125 | 8,641 | 9,167 | 2,500 |
| 1st August | 151 | 15,308 | 4,909 | 3,060 |
| 1st September | 152 | 15,662 | 3,411 | 3,160 |
| 1st October | 152 | 15,662 | 4,528 | 3,160 |
| 1st November | 152 | 15,662 | 1,722 | 3,160 |
| 1st December | 147 | 14,224 | 5,939 | 3,160 |
| *1904.* | | | | |
| 1st January | 152 | 15,662 | 959 | 3,160 |
| 1st February | 145 | 13,461 | 183 | 1,850 |
| 1st March | 138 | 11,794 | 9 | 400 |
| 1st April | 137 | 11,403 | 93 | 400 |
| 1st May | 135 | 11,096 | 134 | 400 |
| 1st June | 134 | 10,830 | 10,110 | 2,500 |
| 1st July | 152 | 15,662 | 9,330 | 2,500 |
| 1st August | 152 | 15,662 | 4,341 | 3,000 |
| 1st September | 152 | 15,662 | 1,400 | 3,160 |
| 1st October | 146 | 13,902 | 4,291 | 3,160 |
| 1st November | 150 | 15,033 | 1,108 | 3,160 |
| 1st December | 143 | 12,981 | 460 | 3,160 |
| *1905.* | | | | |
| 1st January | 132 | 10,281 | 200 | 3,160 |
| 1st February | 118 | 7,321 | 502 | 1,580 |
| Pumping commences 23rd February 1905. | | | | |
| 1st March | 109·6 | 5,943 | 17 | 400 |
| 1st April | 107·2 | 5,560 | 554 | 400 |
| 1st May | 108·1 | 5,714 | 448 | 400 |
| 1st June | 108·5 | 5,762 | 3,484 | 1,450 |
| Water let down 15th June 1905. | | | | |
| 1st July | 120 | 7,796 | 3,672 | 2,500 |
| 1st August | 126 | 8,968 | 1,138 | 3,000 |
| 1st September | 117 | 7,106 | 2,053 | { 1,800<br>891 |
| Full supply ceases 18th September. | | | | |
| 1st October | 113 | 6,468 | 4.575 | 135 |
| | 5th to 10th—Pumping | .. | .. | 80 |
| | 11th—Full supply | .. | .. | 2,107 |

Levels at which water would have been maintained in the lake under the conditions, etc.—*cont.*

| Date. | Water level. | Contents of lake. | Addition during month. | Discharge during month. | |
|---|---|---|---|---|---|
| *1905*—cont. | | | | | |
| 1st November | 125 | 8,721 | 2,566 | 3,160 | |
| 1st December | 122 | 8,127 | 700 | 1,468 | |
| Full supply ceases 15th December | | | | 1,035 | |
| *1906.* | | | | | |
| 1st January | 112 | 6,324 | 221 | 400 | |
| Pumping commences. | | | | | |
| 1st February | 110.9 | 6,145 | 40 | 400 | |
| 1st March | 108·6 | 5,785 | 88 | 400 | |
| 1st April | 106·5 | 5,473 | 45 | 400 | |
| 1st May | 104·3 | 5,118 | 222 | 400 | |
| 1st June | 103·1 | 4,940 | .. | 200 } | |
| 15th ,, | 101·7 | 4,740 | 958 | 200 } | |
| 1st July | 106·7 | 5.498 | 1,026 | 200 } | |
| 15th ,, | 112·0 | 6,324 | 1,285 | 250 } | |
| Pumping ceases. | | | | | |
| 20th July | 118 | 7,359 | 1,998 | 833 } | |
| 1st August | 124 | 8,524 | 6,656 | 3,000 | |
| 1st September | 139 | 12,180 | 1,371 | 3,160 | |
| 1st October | 132 | 10,391 | 2,942 | 3,160 | |
| 1st November | 131 | 10.173 | 3,966 | 3,160 | |
| 1st December | 135 | 10,979 | 1,804 | 3,160 | |
| *1907.* | | | | | |
| 1st January | 129 | 9,623 | 771 | 3,160 | |
| 1st February | 117·5 | 7,234 | 73 | 983 } | |
| 15th ,, | 112 | 6.324 | .. | 200 } | |
| Pumping commences. | | | | | |
| 1st March | 111 | 6.124 | 202 | 400 | |
| 1st April | 109 | 5,926 | 595 | 400 | |
| 1st May | 111 | 6,121 | 70 | 400 | |
| 1st June | 108·6 | 5,791 | .. | 133 } | |
| 11th ,, | 107·8 | 5,658 | 801 | 133 } | 901 |
| 21st ,, | 112·0 | 6,324 | 1,310 | 635 } | |
| Pumping ceases. | | | | | |
| 1st July | 116 | 6,999 | 1,960 | 1,600 } | 2,500 |
| 20th ,, | 118 | 7,359 | 3,382 | 900 } | |
| 1st August | 130 | 9,841 | 11,543 | 3,000 | |
| 1st September | 152 | 15,662 | 1,640 | 3,160 | |
| 1st October | 147 | 14,142 | 5,661 | 3,160 | |
| 1st November | 152 | 15,662 | 9,321 | 3,160 | |
| 1st December | 152 | 15,662 | 1,795 | 3,160 | |
| *1908.* | | | | | |
| 1st January | 147 | 14,297 | 1,417 | 3,160 | |
| 1st February | 141 | 12,554 | 376 | 1,850 | |
| 1st March | 135 | 11,080 | 174 | 400 | |
| 1st April | 134 | 10,854 | .. | .. | |

A. Chatterton,
*Director of Industries.*

27*th March* 1909.

### Appendix A

*Note on the Kullar Reservoir by Mr. K. T. B. Tressler.*

The catchment area of the Kullar has been partially surveyed (G.O., No. 226 I. of 1908), and the portion yet remaining can be determined with sufficient accuracy. On the northern side, the watershed of the Kullar consists of a range of hills running parallel with the Periyár lake. These hills are visible from most of the survey stations established by the Periyár-Pambiyar Survey Party, and their position can therefore be very approximately fixed. The watershed follows this range until it meets a cross range at a point about one mile short of the "Bleak House" camp, and afterwards bears to the south, turning westward again close to "Billingsgate" camp, and approximately following the path to "Jericho". As the position of these camps has been fixed on the map by the investigation party, the tracing of the watershed with reference to them involves very little error indeed.

The area thus defined amounts to about 12 square miles (actually 12·22 square miles).

2. In the appended table are shown the rainfall at Periyár and Tekkadi, and the discharge of the Periyár over a series of years. The earlier figures are taken from Mackenzie's "History of the Periyár Project," the discharges being calculated from a table therein given of the average monthly depths of water on a weir, by means of another table showing the relation of these depths to the discharge. The latter table does not appear to be entirely accurate, nor can the former be accepted without reservations. It is hard, for instance, to reconcile the small discharge during 1890—1901 with the statement that, during this year "the whole work was constantly submerged and interrupted by floods"—a circumstance only possible when the discharge exceeded 2,000 cusecs. The discharges calculated on such data can only therefore be treated as approximate, but as, throughout this period, they always largely exceeded the normal demand, their relative accuracy does not affect the main question.

3. Taking the table as a whole, however, it will at once be seen that there is no direct connection between the river discharge and the rainfall at the dam. The river, in fact, depends for its supply on an area having a distribution of rainfall very different from that at the dam. The discharge from the Kullar catchment, on the other hand, situated as it is at no great distance from the dam, would be more or less proportionate to the rainfall there recorded. The diversion of the Kullar would thus add to the catchment of the Periyár, an area having an entirely different distribution of rainfall. The importance of this point is made clearer by considering the relation between the rainfall and discharge in the case of the two successions of bad years which have so far occurred. In the bad period 1899—1901, the river discharge over the two years was 36 per cent. under normal, whereas the rainfall at the Periyár dam was only 2 per cent. less than the average, and in 1905—1907, when there was an average deficit of 40 per cent. in the discharge, the rainfall was about 1 per cent. over normal. Records then tend to show that this supplementary supply is unaffected when the main source fails—a circumstance the value of which needs no special emphasis.

4. The table discloses another fact also. It will be seen that the rainfall at the dam is persistently higher than that at Tekkadi. The average for the former station is slightly over 80 inches, whereas that for the latter is only 73. This phenomenon is easily explained: Tekkadi is situated at the extreme edge of the plateau: in the south-west monsoon it receives only that moisture which has not already been precipitated in its passage across the mountains—a quantity very much less than that intercepted by ranges further to the south-west. The rainfall at the dam is therefore most largely in excess of that at Tekkadi during the south-west monsoon: and though this excess may be partially balanced by a somewhat greater precipitation at that station during the north-east monsoon, yet, on the whole—as the figures show—there is a distinct balance in favour of the more southerly station. Moreover, as it is the north-east monsoon that usually fails, it is just in such times of partial failure that the advantage becomes most pronounced.

5. Extending the argument, there is reason to believe that the rainfall at the Kullar is in like proportion greater than that at the dam, and the few observations which have been made on the Pambiyar, endorse this opinion. It must be remembered that, not 20 miles away from the dam, the rainfall often reaches 200 inches, so that there would be nothing remarkable in its being 90 or 100 on the Kullar, and no one who has spent some time on the Periyár, and seen the hills on the south capped, day after day, with heavy clouds in spite of the clear sky above him, will question the accuracy of the assumption.

6. Now the periods during which the Kullar supply would have been most necessary, occurred in 1899—1901 and 1904—1907. In the latter case, the deficiency of discharge was very much greater than in the former, so that it is sufficient if we confine our attention to this (1904—1907) period, constituting, as it does, the worst period hitherto recorded. From August 1904 till July 1907, the lake, under the assumed conditions of demand, would have failed to surplus, and any water run into it during this period, could have been stored.

7. In these 34 months the average rainfall at the dam was about 20 per cent. in excess of that at Tekkadi, and it is reasonable—seeing that the Kullar catchment lies rather further south of the Periyár than Tekkadi is north of it—to suppose that the rainfall there is greater than that at the dam in at least the same proportion. The reality of an excess on the Kullar can scarcely be disputed, but it may perhaps be urged that, in the absence of recorded observations on that area, a 20 per cent. allowance on the Periyár figures is excessive. An increase of 10 per cent., however,—a figure representing the average difference between the Periyár and Tekkadi rainfall—may be taken as a conservative estimate of the probable rainfall in the Kullar catchment.

8. Now between 26th August 1904 (when the lake ceased to surplus) and 15th June 1907 (when, without power, irrigation could have been begun), the rainfall at the dam was 203½ inches, which, on our assumption, would represent 224 inches on the Kullar. Mackenzie in the "History of the Periyár Project" gives the percentage run-off as five-ninths for this district, and so, assuming the catchment to be 12 square miles, the total quantity of useful water which this river could have furnished during the worst period on record, works out at 3,470,000,000 cubic feet—an amount practically equivalent to that assumed to have been abstracted from the lake for purely power purposes in this interval.

9. To divert this water into the Periyár lake, it would be necessary to construct a dam across the Kullar. Since the lowest point on the watershed separating the two rivers is about 55 feet above the bed of the Kullar at the site of the proposed dam, a dam of this height would effect the diversion without any cutting down of the watershed. Lowering the watershed ridge would involve blasting, but the stone so obtained could be utilised in the construction of the dam, the necessary height of which would naturally be considerably reduced by the excavation of a channel through the ridge. The rates paid on the Periyár dam for blasting were Rs. 12 per 100 cubic feet, and those for uncoursed rubble masonry Rs. 30 per 100 cubic feet. It thus appears that the most economical combination consists of a cutting 20 feet wide by 15 feet deep to carry 10 feet of water, and a dam 43 feet high. This would necessitate the removal of about 300,000 cubic feet of rock by blasting, costing, at the Periyár rates, Rs. 36,000, and the construction of a dam 43 feet high, containing about 140,000 cubic feet of masonry, and costing Rs. 42,000. Total, Rs. 78,000. These figures do not include the cost of machinery and supervision, but a lakh of rupees should be sufficient to cover the cost of the work.

10. It is to be noted that the proposed dam requires no escape, since the watershed cutting constitutes the surplus weir. Under the present proposal, the water of the Kullar is completely diverted, but no provision is made for storage. As storage on the Kullar could only be effected at a comparatively high cost, and as it is considered that the supply to be obtained from the diversion would amply compensate irrigation for any water which may have been utilised for power purposes, it seems unnecessary in the present note to enter into the details of this question.

K. T. B. Tressler.

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*Table I showing the Rainfall and Discharge.*

| Year. | Rainfall at | | Discharge of Periyár. | Percentage excess. | | As corrected in the Chief Engineer's office. | |
|---|---|---|---|---|---|---|---|
| | Tekkadi. | Periyár. | | Rainfall. | Discharge. | Discharge of Periyár (col. 4). | Percentage excess. Discharge (col. 6). |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| 1888–1889 | .. | 104·75 | .. | .. | .. | .. | .. |
| 1889–1890 | .. | 93·96 | 52,690 | + 17 | + 46 | 52,690 | + 46 |
| 1890–1891 | .. | 57·70 | 32,580 | — 28 | — 9 | 32,580 | — 9 |
| 1891–1892 | .. | 67·40 | 52,420 | — 16 | + 45 | 52,420 | + 45 |
| 1892–1893 | .. | 62·28 | 44,550 | — 22 | + 24 | 44,550 | + 24 |
| 1893–1894 | .. | 63·13 | 44,140 | — 21 | + 23 | 44,140 | + 23 |
| 1894–1895 | .. | 70·44 | 46,920 | — 11 | + 30 | 46,920 | + 30 |
| 1895–1896 | .. | 85·95 | .. | + 4 | .. | .. | .. |
| 1896–1897 | .. | .. | .. | .. | .. | 41,702 | + 16 |
| 1897–1898 | 94·30 | .. | 41,738 | + 37 | + 16 | 36,478 | + 2 |
| 1898–1899 | 71·43 | .. | 36,478 | — 3 | + 2 | 21,313 | — 41 |
| 1899–1900 | 63·60 | .. | 21,413 | — 13 | — 41 | 24,549 | — 32 |
| 1900–1901 | 78·85 | .. | 24,549 | + 9 | — 32 | 39,632 | + 10 |
| 1901–1902 | 61·00 | 73·00 | 39,632 | — 9 | + 10 | 29,785 | — 17 |
| 1902–1903 | 72·75 | 72·05 | 29,785 | — 10 | — 17 | 34,363 | — 5 |
| 1903–1904 | 75·70 | 78·66 | 34,394 | — 2 | — 5 | 31,816 | — 12 |
| 1904–1905 | 68·25 | 90·15 | 31,736 | + 12 | — 12 | 31,992 | — 12 |
| 1905–1906 | 65·55 | 75·95 | 19,542 | — 5 | — 46 | 19,543 | — 46 |
| 1906–1907 | 69·45 | 85·70 | 23,324 | + 7 | — 35 | 23,324 | — 35 |
| 1907–1908 | 85·46 | 121·48 | 40,061 | + 51 | + 11 | 40,051 | + 11 |

## VI

### Note by the Chief Engineer for Irrigation, dated 11th June 1909.

Mr. Chatterton first submitted a power scheme which required an average discharge throughout the year of 110 cusecs and in connection with this, it was shown that it was impracticable to guarantee more than 50 cusecs without reserving water at the expense of irrigation for the use of power during the closure months and this was considered to be inadmissible. Mr. Chatterton has now submitted a modified scheme requiring an average discharge of 315 cusecs for 12 hours a day or 157 cusecs for 24 hours and proposes to get over the difficulty of interference with irrigation as follows:—

(*a*) By pumping water from below the offtake level when water is not otherwise available, which suggestion, I may mention, was made by Mr. Garrett in connection with his original scheme.

(*b*) By compensating for the water thus abstracted from the lake by diverting into the Periyár reservoir an additional catchment area of 12 square miles from the Kullar river.

2. I do not propose in this note to make any attempt to criticise in detail Mr. Chatterton's proposals as regards the power plant, but will merely remark that the figures of cost given are only approximate ones and in comparison with those of Major de Lotbiniere in connection with Mr. Garrett's scheme, appear to be low. I shall therefore only deal with the scheme as regards the supply of water and its possible effect upon Periyár irrigation.

3. The tables prepared by Mr. Tressler, though based upon data supplied by the Irrigation Chief Engineer's office, are not in the form usually adopted in that office and I have therefore had a fresh set prepared in the latter form, but on the same data.

The demands for irrigation amount to 25,650 millions cubic feet for a period of ten months and allow for as large a discharge as it is normally possible to utilise with the existing tunnel capacity, making no allowance for rainfall on the irrigated tract. It may be pointed out that these demands are much in excess of what it has hitherto been found possible to utilise, the maximum supply used up to date in any one season being 21,982 millions cubic feet in 1901–1902, which is equivalent to 82 per cent. of the average discharge of the Periyár for the past eleven years, 31,212 millions cubic feet. It is further pointed out that as the river supply varies from a maximum of 41,702 millions cubic feet to a minimum of 19,543 millions cubic feet and as in at least two consecutive years, there may occur a short supply in which the lake does not fill, the ultimate irrigable area must, even if the tunnel is enlarged, be limited to some extent by the minimum supply in the river. Proposals like the present ones which provide for a normal supply 30 per cent. in excess of this minimum, may therefore be reasonably assumed to be likely to suit such altered conditions. In other words, although no draw-off tables have at present been worked out with an enlarged tunnel, it may be for the present assumed that 25,650 millions cubic feet is as much of the available supply of the river as will on the average be ever utilised with the present catchment area even with an enlarged tunnel. In the event of any material increase to the catchment area, such as would be obtained by the diversion of the Pambiyar, conditions would, of course, be materially improved both for irrigation and power.

4. As regards Mr. Chatterton's suggestion (*b*), it may be remarked that the present catchment of the Periyár is estimated to be 305 square miles and the addition of 12 square miles is equivalent to an increase in area of 4 per cent., and from the nature of the Kullar catchment, it will not be unreasonable to assume that a corresponding increase of 4 per cent. in the river supply will result.

The calculated effect of the Kullar diversion is based upon this assumption and this effect, as well as the effect of the pumping scheme, is shown in the following analysis of the tables for each year from 1896–97 to 1907–1908:—

*1896–97.*—No effect. Supplies ample.

*1897–98.*—No effect. Supplies ample.

*1898–99.*—No ill-effect on irrigation. Supplies deficient January and February; that in January would have been saved by Kullar.

*1899–1900.*—No effect on irrigation in June owing to lake receiving supplies in April 1899. Supplies deficient January 1900, February 1900. No ill-effect. Kullar would have supplied January deficiency.

*1900–1901.*—Reservoir had to fill up in June from 105·5 to 112 = 1,023 millions cubic feet. The lake diagram shows this would have taken twelve days to June 24th Ample water at the end of the year, really no effect on irrigation, but more would have run to waste.

*1901–1902.*—Supplies ample. No effect.

*1902–1903.*—Supplies ample. No effect.

*1903–1904.*—Supplies ample. No effect.

*1904–1905.*—No ill-effect. Slight defect in February. Would have been saved by Kullar.

*1905–1906.*—In this year there would have been without power about 1,000 millions cubic feet available on 1st June; with power there was none; no supply except the 13·3 millions cubic feet used daily for power, would have been available till June 20th when supplies were received. The supplies were generally deficient throughout the year, the river supply being 19,543 millions cubic feet. Four per cent. on this (780 millions) due to the Kullar would probably have been more useful than the 1,000 millions run out of the lake in the first part of June, before anyone knew supplies would be short.

*1906–1907.*—The year was started with lake empty; with power it would have started with a deficiency of 1,400 millions to be made up. The lake diagram shows conclusively that water would not rise to 112 until July 20th; however, actual supplies were little if anything more than would be used for power, as, at the actual water levels throughout 1st June—20th July, the cutting can only discharge a small supply, probably not more than 1,000 or 1,100 millions against 660 with power and there would have been a certain amount stored in the tanks to balance the difference. Deficiencies are shown in January and February amounting to 1,757 millions, but the supply from the Kullar 4 per cent. on 23,323 = 933 millions will make up fully for half of this. The deficiency is not due to power and irrigation benefits.

6,324 — 4,940 = 1,384.

*1907–1908.*—Without power there would have been on June 1st, 940 millions available. With power there would have been a deficiency and irrigation would have had to wait till the lake rose on June 15th; there was ample water for the rest of the year.

The irrigation demands are placed very high. No account being taken of the rainfall on the ayacut, it is more than probable that this and the Kullar supplies would have enabled the reservoir to start fairly well in 1905–1906.

The project would have benefited distinctly by the Kullar extension scheme in 1898–99, 1899–1900 and 1904–1905. I think there is as much in favour of, as against, the power scheme in the bad years 1905–1906 and 1906–1907. In the other years, the proposal has no effect on irrigation.

Mr. Tressler's calculations have been checked and found generally correct; also his tables show water levels very approximately the same as our independent calculations.

5. The general conclusions from the above are that the addition of the Kullar catchment will compensate for the interference with irrigation resulting from the power scheme which interference is usually limited to throwing back the date of opening the tunnel for irrigation.

As a matter of fact, even this interference is not very material, as it is at present usual, when the reservoir is low at the end of a season, to wait until the south-west monsoon bursts before opening the tunnel, and as soon as the monsoon does burst, the lake usually fills up fairly quickly to a sufficient height.

It is to be noted that without the addition of the Kullar the available supply in the lake would have been reduced in each of the years 1905–1906, 1906–1907 and 1907–1908 by the water drawn off in March, April and May 1905, 1906 and 1907; respectively, and that this interference would not be justifiable.

6. It is admitted that the scheme involves passing water through the tunnel during this period when under existing conditions it is usually closed for irrigation.

While, however, the Chief Engineer for Irrigation is not prepared without further evidence to agree with Mr. Chatterton's original expectations that this water will be utilised for crops, such as sugarcane, etc., and a higher water-rate than usual realized therefrom, experience in the Madras Presidency has shown that when a perennial supply of water is available, it is invariably utilised by the ryots for irrigation and it is therefore fair to assume that this supply will not be wasted.

7. On the whole, the Chief Engineer for Irrigation is of opinion that the scheme on the lines now proposed by Mr. Chatterton is unobjectionable as regards its possible effect upon irrigation, more especially, as it involves no guarantee on the part of Government to maintain the supply of water through the tunnel for power.

C. A. Smith,
*Chief Engineer for Irrigation.*

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Enclosure.

*Periyar Power Scheme Tables.*

| Month. | Total discharge of Periyár. | Balance in reservoir on the first of the month. | Total supply available. | Demand. | Balance in reservoir at the end of the month. | Lake level corre-sponding. | Surplus or deficiency. |
|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| | | | *1896–1897.* | | | | |
| August | 5,851 | 15,662 | 21,513 | 3,000 | 15,662 | 152 | + 2,851 |
| September | 1,349 | 15,662 | 17,011 | 3,160 | 13,851 | 146 | .. |
| October | 3,452 | 13,851 | 17,303 | 3,160 | 14,143 | 147 | .. |
| November | 7,720 | 14,143 | 21,863 | 3,160 | 15,662 | 152 | + 3,041 |
| December | 3,932 | 15,662 | 19,594 | 3,160 | 15,662 | 152 | + 772 |
| January | 736 | 15,662 | 16,398 | 3,160 | 13,238 | 144 | .. |
| February | 756 | 13,238 | 13,994 | 1,850 | 12,144 | 140 | .. |
| March | 487 | 12,144 | 12,631 | 400 | 12,231 | 140 | .. |
| April | 370 | 12,231 | 12,601 | 400 | 12,201 | 140 | .. |
| May | 162 | 12,201 | 12,363 | 400 | 11,963 | 139 | .. |
| | | | *1897–1898.* | | | | |
| June | 8,204 | 11,963 | 20,167 | 2,500 | 15,662 | 152 | + 2,005 |
| July | 6,292 | 15,662 | 21,954 | 2,500 | 15,662 | 152 | + 3,792 |
| August | 9,974 | 15,662 | 25,636 | 3,000 | 15,662 | 152 | + 6,974 |
| September | 2,047 | 15,662 | 17,709 | 3,160 | 14,549 | 148 | .. |
| October | 2,479 | 14,549 | 17,028 | 3,160 | 13,868 | 146 | .. |
| November | 4,268 | 13,868 | 18,136 | 3,160 | 14,976 | 150 | .. |
| December | 977 | 14,976 | 15,953 | 3,160 | 12,793 | 142 | .. |
| January | 611 | 12,793 | 13,404 | 3,160 | 10,244 | 132 | .. |
| February | 901 | 10,244 | 11,145 | 1,850 | 9,295 | 127 | .. |
| March | 188 | 9,295 | 9,483 | 400 | 9,083 | 126 | .. |
| April | 118 | 9,083 | 9,201 | 400 | 8,801 | 125 | .. |
| May | 373 | 8,801 | 9,174 | 400 | 8,774 | 125 | .. |
| | | | *1898–1899.* | | | | |
| June | 2,937 | 8,774 | 11,711 | 2,500 | 9,211 | 127 | .. |
| July | 3,984 | 9,211 | 13,195 | 2,500 | 10,695 | 134 | .. |
| August | 1,263 | 10,695 | 11,958 | 3,000 | 8,958 | 126 | .. |
| September | 1,059 | 8,958 | 10,017 | 3,160 | 6,857 | 115 | .. |
| October | 5,120 | 6,857 | 11,977 | 3,160 | 8,817 | 125 | .. |
| November | 3,728 | 8,817 | 12,545 | 3,160 | 9,385 | 128 | .. |
| December | 1,719 | 9,385 | 11,104 | 3,160 | 7,944 | 121 | .. |
| January | 800 | 7,944 | 8,744 | 2,420 | 6,324 | 112 | — 740 |
| February | 158 | 6,324 | 6,482 | 400 | 6,082 | 110·5 | — 1,450* |
| March | 49 | 6,082 | 6,131 | 400 | 5,731 | 108·2 | .. |
| April | 2,945 | 5,731 | 8,676 | 400 | 8,276 | 122 | .. |
| May | 482 | 8,276 | 8,758 | 400 | 8,358 | 123 | .. |

* Power gives 400 to Irrigation.

| Month. | Total discharge of Periyár. | Balance in reservoir on the first of the month. | Total supply available. | Demand. | Balance in reservoir at the end of the month. | Lake level corre-sponding. | Surplus or deficiency. |
|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| | | | *1899–1900.* | | | | |
| June .. .. .. .. | 4,300 | 8,358 | 12,658 | 2,500 | 10,158 | 131 | .. |
| July .. .. .. .. | 8,207 | 10,158 | 18,365 | 2,500 | 15,662 | 152 | + 203 |
| August .. .. .. .. | 1,128 | 15,662 | 16,790 | 3,000 | 13,790 | 145 | .. |
| September .. .. .. .. | 742 | 13,790 | 14,532 | 3,160 | 11,372 | 137 | .. |
| October .. .. .. .. | 3,518 | 11,372 | 14,890 | 3,160 | 11,730 | 138 | .. |
| November .. .. .. .. | 1,471 | 11,730 | 13,201 | 3,160 | 10,041 | 131 | .. |
| December .. .. .. .. | 1,467 | 10,041 | 11,508 | 3,160 | 8,348 | 123 | .. |
| January .. .. .. .. | 212 | 8,348 | 8,560 | 2,220 | 6,324 | 112 | .. |
| February .. .. .. .. | 50 | 6,324 | 6,374 | 400 | 5,974 | 109·8 | — 940 |
| March .. .. .. .. | 20 | 5,974 | 5,994 | 400 | 5,594 | 107·0 | —1,450 |
| April .. .. .. .. | 187 | 5,594 | 5,781 | 400 | 5,381 | 106 | .. |
| May .. .. .. .. | 346 | 5,381 | 5,727 | 400 | 5,327 | 105·5 | .. |
| | | | *1900–1901.* | | | | |
| June .. .. .. .. | 8,159 | 5,327 | 8,486 | 2,162* | 6,324 | 112 | — 338 |
| July .. .. .. .. | 9,325 | 6,324 | 15,649 | 2,500 | 13,149 | 143 | .. |
| August .. .. .. .. | 13,002 | 13,149 | 26,151 | 3,000 | 15,662 | 152 | + 7,489 |
| September .. .. .. .. | 2,448 | 15,662 | 18,110 | 3,160 | 14,950 | 150 | .. |
| October .. .. .. .. | 2,589 | 14,950 | 17,539 | 3,160 | 14,379 | 148 | .. |
| November .. .. .. .. | 3,922 | 14,379 | 18,301 | 3,160 | 15,141 | 150 | .. |
| December .. .. .. .. | 1,702 | 15,141 | 16,843 | 3,160 | 13,683 | 145 | .. |
| January .. .. .. .. | 1,220 | 13,683 | 14,903 | 3,160 | 11,743 | 138 | .. |
| February .. .. .. .. | 493 | 11,743 | 12,236 | 1,850 | 10,386 | 133 | .. |
| March .. .. .. .. | 1,232 | 10,386 | 11,618 | 400 | 11,218 | 136 | .. |
| April .. .. .. .. | 540 | 11,218 | 11,758 | 400 | 11,358 | 137 | .. |
| May .. .. .. .. | 188 | 11,358 | 11,546 | 400 | 11,146 | 136 | .. |
| | | | *1901–1902.* | | | | |
| June .. .. .. .. | 4,080 | 11,146 | 15,226 | 2,500 | 12,726 | 142 | .. |
| July .. .. .. .. | 7,666 | 12,726 | 20,392 | 2,500 | 15,662 | 152 | + 2,230 |
| August .. .. .. .. | 3,257 | 15,662 | 18,919 | 3,000 | 15,662 | 152 | + 257 |
| September .. .. .. .. | 1,219 | 15,662 | 16,881 | 3,160 | 13,721 | 146 | .. |
| October .. .. .. .. | 2,591 | 13,721 | 16,312 | 3,160 | 13,152 | 143 | .. |
| November .. .. .. .. | 6,036 | 13,152 | 19,188 | 3,160 | 15,662 | 152 | + 366 |
| December .. .. .. .. | 1,450 | 15,662 | 17,112 | 3,160 | 13,952 | 146 | .. |
| January .. .. .. .. | 2,467 | 13,952 | 16,419 | 3,160 | 13,259 | 144 | .. |
| February .. .. .. .. | 264 | 13,259 | 13,523 | 1,850 | 11,673 | 138 | .. |
| March .. .. .. .. | 22 | 11,673 | 11,695 | 400 | 11,295 | 136 | .. |
| April .. .. .. .. | 151 | 11,295 | 11,446 | 400 | 11,046 | 135 | .. |
| May .. .. .. .. | 75 | 11,046 | 11,121 | 400 | 10,721 | 134 | .. |
| | | | *1902–1903.* | | | | |
| June .. .. .. .. | 58 | 10,721 | 10,779 | 2,500 | 8,279 | 123 | .. |
| July .. .. .. .. | 5,814 | 8,279 | 14,093 | 2,500 | 11,593 | 137 | .. |
| August .. .. .. .. | 1,591 | 11,593 | 13,184 | 3,000 | 10,184 | 131 | .. |
| September .. .. .. .. | 3,324 | 10,184 | 13,508 | 3,160 | 10,348 | 132 | .. |
| October .. .. .. .. | 8,323 | 10,348 | 18,671 | 3,160 | 15,511 | 152 | .. |
| November .. .. .. .. | 7,461 | 15,511 | 22,972 | 3,160 | 15,662 | 152 | + 4,150 |
| December .. .. .. .. | 6,872 | 15,662 | 22,534 | 3,160 | 15,662 | 152 | + 3,712 |
| January .. .. .. .. | 551 | 15,662 | 16,213 | 3,160 | 13,053 | 143 | .. |
| February .. .. .. .. | 153 | 13,053 | 13,206 | 1,850 | 11,356 | 138 | .. |
| March .. .. .. .. | .. | 11,356 | 11,356 | 400 | 10,956 | 135 | .. |
| April .. .. .. .. | 23 | 10,956 | 10,979 | 400 | 10,579 | 133 | .. |
| May .. .. .. .. | 280 | 10,579 | 10,859 | 400 | 10,459 | 133 | .. |
| | | | *1903–1904.* | | | | |
| June .. .. .. .. | 682 | 10,459 | 11,141 | 2,500 | 8,641 | 125 | .. |
| July .. .. .. .. | 9,167 | 8,641 | 17,808 | 2,500 | 15,308 | 151 | .. |
| August .. .. .. .. | 4,909 | 15,308 | 20,217 | 3,000 | 15,662 | 152 | + 1,555 |
| September .. .. .. .. | 3,411 | 15,662 | 19,073 | 3,160 | 15,662 | 152 | + 251 |
| October .. .. .. .. | 4,528 | 15,662 | 20,190 | 3,160 | 15,662 | 152 | + 1,368 |
| November .. .. .. .. | 1,722 | 15,662 | 17,384 | 3,160 | 14,224 | 147 | .. |
| December .. .. .. .. | 5,939 | 14,224 | 20,163 | 3,160 | 15,662 | 152 | + 1,341 |
| January .. .. .. .. | 959 | 15,662 | 16,621 | 3,160 | 13,461 | 145 | .. |
| February .. .. .. .. | 183 | 13,461 | 13,644 | 1,850 | 11,794 | 138 | .. |
| March .. .. .. .. | 9 | 11,794 | 11,803 | 400 | 11,403 | 137 | .. |
| April .. .. .. .. | 93 | 11,403 | 11,496 | 400 | 11,096 | 135 | .. |
| May .. .. .. .. | 134 | 11,096 | 11,230 | 400 | 10,830 | 134 | .. |

* This could not have been used. Water reaches 112 about the 24th only. About $400 \times \frac{24}{30} + 600 = 920$ millions could have been used.

| Month. | Total discharge of Periyár. | Balance in reservoir on the first of the month. | Total supply available. | Demand. | Balance in reservoir at the end of the month. | Lake level corre-sponding. | Surplus or deficiency. |
|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| | | | *1904–1905.* | | | | |
| June .. .. .. .. | 10,110 | 10,830 | 20,940 | 2,500 | 15,662 | 152 | + 2,778 |
| July .. .. .. .. | 9,330 | 15,662 | 24,992 | 2,500 | 15,662 | 152 | + 6,830 |
| August .. .. .. .. | 4,341 | 15,662 | 20,003 | 3,000 | 15,662 | 152 | + 1,341 |
| September .. .. .. .. | 1,400 | 15,662 | 17,062 | 3,160 | 13,902 | 146 | .. |
| October .. .. .. .. | 4,291 | 13,902 | 18,193 | 3,160 | 15,033 | 150 | .. |
| November .. .. .. .. | 1,108 | 15,033 | 16,141 | 3,160 | 12,981 | 143 | .. |
| December .. .. .. .. | 460 | 12,981 | 13,441 | 3,160 | 10,281 | 132 | .. |
| January .. .. .. .. | 200 | 10,281 | 10,481 | 3,160 | 7,321 | 118 | .. |
| February .. .. .. .. | 502 | 7,321 | 7,823 | 1,499 | 6,324 | 112 | — 354 |
| March .. .. .. .. | 17 | 6,324 | 6,341 | 400 | 5,941 | 109·6 | .. |
| April .. .. .. .. | 554 | 5,941 | 6,495 | 400 | 6,095 | 110·6 | .. |
| May .. .. .. .. | 448 | 6,095 | 6,543 | 400 | 6,143 | 111 | .. |
| | | | *1905–1906.* | | | | |
| June .. .. .. .. | 3,484 | 6,143 | 9,627 | 2,500 | 7,127 | 117 | .. |
| July .. .. .. .. | 3,672 | 7,127 | 10,799 | 2,500 | 8,299 | 121 | .. |
| August .. .. .. .. | 1,138 | 8,299 | 9,437 | 3,000 | 6,437 | 113 | .. |
| September .. .. .. .. | 2,053 | 6,437 | 8,490 | 2,166 | 6,324 | 112 | — 994 |
| October .. .. .. .. | 4,575 | 6,324 | 10,899 | 3,160 | 6,739 | 114·5 | .. |
| November .. .. .. .. | 2,566 | 6,739 | 9,305 | 1,981 | 6,324 | 112 | — 1,179 |
| December .. .. .. .. | 700 | 6,324 | 7,024 | 700 | 6,324 | 112 | — 2,460 |
| January .. .. .. .. | 221 | 6,324 | 6,545 | 400 | 6,145 | 111 | — 2,760 |
| February .. .. .. .. | 40 | 6,145 | 6,185 | 400 | 5,785 | 108·5 | — 1,450 |
| March .. .. .. .. | 88 | 5,785 | 5,873 | 400 | 5,473 | 106·6 | .. |
| April .. .. .. .. | 45 | 5,473 | 5,518 | 400 | 5,118 | 104·3 | .. |
| May .. .. .. .. | 222 | 5,118 | 5,340 | 400 | 4,940 | 102·9 | .. |
| | | | *1906–1907.* | | | | |
| June .. .. .. .. | 958 | 4,940 | 5,898 | 400 | 5,498 | 106·8 | — 2,100 |
| July .. .. .. .. | 4,309 | 5,498 | 9,807 | 2,500 | 7,307 | 118 | .. |
| August .. .. .. .. | 6,656 | 7,307 | 13,963 | 3,000 | 10,963 | 135 | .. |
| September .. .. .. .. | 1,371 | 10,963 | 12,334 | 3,160 | 9,174 | 127 | .. |
| October .. .. .. .. | 2,942 | 9,174 | 12,116 | 3,160 | 8,956 | 126 | .. |
| November .. .. .. .. | 3,966 | 8,956 | 12,922 | 3,160 | 9,762 | 130 | .. |
| December .. .. .. .. | 1,804 | 9,762 | 11,566 | 3,160 | 8,406 | 123 | .. |
| January .. .. .. .. | 771 | 8,406 | 9,177 | 2,853 | 6,324 | 112 | — 307 |
| February .. .. .. .. | 73 | 6,324 | 6,397 | 400 | 5,997 | 110 | — 1,450 |
| March .. .. .. .. | 202 | 5,997 | 6,199 | 400 | 5,799 | 108·7 | .. |
| April .. .. .. .. | 595 | 5,799 | 6,394 | 400 | 5,994 | 110 | .. |
| May .. .. .. .. | 70 | 5,994 | 6,064 | 400 | 5,664 | 108 | .. |
| | | | *1907–1908.* | | | | |
| June .. .. .. .. | 2,111 | 5,664 | 7,775 | 1,451 | 6,324 | 112 | — 1,049 |
| July .. .. .. .. | 5,342 | 6,324 | 11,666 | 2,500 | 9,166 | 127 | .. |
| August .. .. .. .. | 11,543 | 9,166 | 20,609 | 3,000 | 15,662 | 152 | + 1,947 |
| September .. .. .. .. | 1,640 | 15,662 | 17,302 | 3,160 | 14,142 | 147 | .. |
| October .. .. .. .. | 5,661 | 14,142 | 19,803 | 3,160 | 15,662 | 152 | + 981 |
| November .. .. .. .. | 9,321 | 15,662 | 24,983 | 3,160 | 15,662 | 152 | + 6,161 |
| December .. .. .. .. | 1,795 | 15,662 | 17,457 | 3,160 | 14,297 | 147 | .. |
| January .. .. .. .. | 1,417 | 14,297 | 15,714 | 3,160 | 12,554 | 141 | .. |
| February .. .. .. .. | 376 | 12,554 | 12,930 | 1,850 | 11,080 | 135 | .. |
| March .. .. .. .. | 174 | 11,080 | 11,254 | 400 | 10,854 | 134 | .. |

**Order—No. 274 I., dated 28th June 1909.**

The scheme described in Mr. Chatterton's letter No. 74-G., dated 27th March 1909, will be submitted to the Government of India and their approval obtained to its being proceeded with in detail.

2. The following letter will be addressed.

[Here enter No. 275 I., dated 28th June 1909.]

(True Extract.)

C. A. SMITH,
*Joint Secretary to Govt., P. W. D.,*
*Irrigation Branch.*

To the Chief Engineer for Irrigation.
,, Superintending Engineer, VI Circle.
,, Director of Industries.

Copy to the Revenue department.

GOVERNMENT OF MADRAS.

PUBLIC WORKS DEPARTMENT.

No. 275 I.

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**Irrigation.**

From

C. A. SMITH, Esq.,
*Joint Secretary to the Government of Madras,*
*Public Works Department (Irrigation Branch),*

To

THE SECRETARY TO THE GOVERNMENT OF INDIA,
PUBLIC WORKS DEPARTMENT.

SIR,

I am directed to address you on the question of establishing a hydro-electric station for the utilization of the water power available at the Periyár.

2. In this Government's letter No. 1021 I., dated 28th October 1905, a scheme prepared by Mr. Garrett was submitted to the Government of India which required a continuous discharge of 500 cusecs. In their letter No. 573 I., dated 4th May 1906, the Government of India condemned the scheme on the recommendation of the Inspector-General of Irrigation, Mr. Benton, who in his note accompanying that letter clearly proved that the scheme would have failed completely in 1905–1906 for want of water. On receipt of this letter from the Government of India, attempts were made to work out a scheme requiring a discharge of 250 cusecs, but this was also impracticable without considerable interference with irrigation. It was accordingly decided that the matter should be dropped, until the results were known of the investigation of the Periyár-Pambiyar scheme for increasing the catchment area of the Periyár lake. This question was also ordered to lie over until either the catchment area of both rivers had been surveyed or the Pambiyar had been gauged for a sufficient number of years to enable calculations to be made of the possible effects upon the Periyár water-supply of the diversion of the Pambiyar (*vide* this Government's endorsement No. 227 I., dated 17th June 1908).

3. With his letter No. 74 G., dated 27th March 1909 (Annexure A), Mr. Chatterton, Director of Industries, submitted, after personal discussion with Mr. Benton, the Inspector-General of Irrigation, a scheme drawn up by Mr. Tressler, Assistant Engineer, which in place of requiring water to be specially stored for power purposes above the offtake level of the Periyár lake at the expense of irrigation, provides that any possible deficiencies should be made good by pumping water from the lake from below this level.

4. The scheme has been examined as regards the water-supply by the Chief Engineer for Irrigation who has prepared a set of tables and a note showing the effect of the scheme on irrigation (*vide* Annexure B). The Government agree with the Chief Engineer for Irrigation that the comparatively small quantity of

water now proposed to be passed down during the dry months will be utilized by the ryots and although no trustworthy forecast of the resulting revenue can be made, it is certain that some return can be expected. The scheme is therefore free from the objection that water stored at great expense for irrigation will be run to waste for the purpose of generating power.

5. It will be seen from the Chief Engineer's note that that portion of the scheme relating to the diversion of the Kullar is essential to prevent objectionable interference with the supplies available at the beginning of seasons following years of short supply and that the additional supply estimated to be obtained from the Kullar diversion is in some years a material assistance to irrigation. The Government therefore agree with the Chief Engineer for Irrigation that the scheme, as now drawn up and including the Kullar diversion, will not prejudice irrigation and accordingly recommend that its further investigation may be approved by the Government of India.

6. If this is approved, a further report on the conditions on which the power scheme should be carried out, will be submitted. As at present advised, the Government propose to give no guarantee that the supply will be constant, although there will in fact be ample water in the lake below the level of the offtake to supply the required quantity for many months. It will therefore rest with the concessionaires, supposing the power is leased out, to calculate their maximum possible requirements in this direction and provide the requisite pumping plant. The Government also do not propose to assume any responsibility for the scheme further than to advertise that water sufficient for about 20,000 Horse Power for twelve hours per diem is available and that it will be leased out at a fixed rate per Water-Horse-Power.

7. I am to request that the Government of India will favour this Government with their opinion on this outline of the methods by which it is proposed to deal with the disposal of the power and with any further recommendations that may suggest themselves.

I have the honour to be,

Sir,

Your most obedient servant,

C. A. SMITH,

*Joint Secretary to Govt., P.W.D.,*
*Irrigation Branch.*

OOTACAMUND,
28*th June* 1909.

*Documents accompanying.*

1. ANNEXURE A.—Letter No. 74 G., dated 27th March 1909, from Mr. Chatterton, with enclosures (in print).

2. ANNEXURE B.—Note by the Chief Engineer for Irrigation, dated 11th June 1909, with table (in print).

3. Diagram showing levels at which water would have been maintained in the lake under the conditions detailed in Mr. Chatterton's note.

4. Portfolio of Periyár lake diagrams from 1896-97 to 1907–1908.

[Annexures.

## ANNEXURE A.

*Letter*—from A. CHATTERTON, Esq., Director of Industries, Madras.
*To*—the Secretary to Government, Revenue Department.
*Dated*—the 27th March 1909.
*No.*—74-G.

In continuation of my No. 74-G. of the 1st March 1909, I have the honour to forward a further note on the proposals for establishing a hydro-electric station for the utilisation of the water power available at the Periyár.

2. The question was discussed with the Inspector-General of Irrigation at a meeting which was held at the Government House, Guindy, on the 15th of March when His Excellency the Governor, Mr. Benton, the Inspector-General of Irrigation, Mr. Wilson, the Chief Engineer, and Mr. Smith, the Chief Engineer for Irrigation, were present. At that discussion, Mr. Benton said he did not think any proposals could be sanctioned, which involved retaining water in the Periyár lake for the purpose of supplying power during the hot weather months. There must be, he said, no restraint placed upon the supply of water for irrigation, but he was prepared to consider a scheme which involved pumping water out of the lake below the level of the watershed cutting, and he suggested that the effect of this should be worked out and submitted to him in detail. This I have done and I now submit the results of the same in a tabular statement attached to the note referred to above.

3. Neither Mr. Benton nor the Chief Engineer for Irrigation accepts my views regarding the value of an absolutely certain perennial supply of water. Time must be allowed for further evidence on this point to accumulate, but, in the meantime, I base the feasibility of my proposals for developing this water power solely on the ground that, if they are carried out, there will be a reasonable return on the capital outlay, and the industries of the Madura district will be greatly benefited by a large supply of cheap power. As will be seen from the note, pumping water from the lake during the hot weather months means that in years of deficient rainfall, there will be some delay in starting irrigation due to the time required to refill the lake to the level at which the necessary supply can be passed down the watershed cutting by gravitation. I would submit that this delay is not a very serious disadvantage, that it will cause little or no loss to the ryots and that generally the slight interference with irrigation may well be borne to secure the advantages of a cheap supply of power. At the end of the irrigation season, the provision for pumping water from the lake, after it has ceased to discharge naturally, is a distinct advantage to the irrigation, inasmuch as it enables a certain supply of water to be sent down which would otherwise have remained unutilized in the lake.

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ENCLOSURES.

### NOTE.

From the Chief Engineer for Irrigation, I have received the following data. The normal requirements for irrigation are—

2,500 millions cubic feet of water per month in June and July.
3,000 ,, ,, in August.
3,160 ,, ,, in September, October, November, December and January.
1,850 ,, ,, in February.

From the 1st of March to the 1st of June, water is not required for the irrigation of the lands under the Periyár Project.

2. Printed tables giving the capacity of the Periyár lake at various levels have been furnished to me and from these data I have endeavoured to ascertain what would have been the condition of the Periyár lake at any time since the 1st of August 1896 to the 1st of April 1908, assuming that the normal requirements of the irrigation were passed off through the tunnel and that during the whole period a minimum supply of 400 millions cubic feet a month was maintained for the

generation of power. The water passes from the reservoir to the tunnel of the watershed through a cutting, the highest level of which I have taken to be 108. The bottom width of this cutting is 35 feet and the sides are vertical. With 10 feet depth of water in the cutting, I calculate the discharge will be 1,245 cubic feet per second or slightly above that required to maintain the full supply of 3,160 millions cubic feet per month. With 4 feet depth of water in the cutting, I calculate that the discharge would be 315 cusecs or slightly more than 400 millions cubic feet a month assuming that the water is only allowed to flow for twelve hours a day. Till the water in the lake falls to the level of 112, the power scheme will in no way interfere with the supply of water for irrigation, but after it has reached that level, I have assumed that water will only be discharged from the lake for twelve hours a day and that the quantity will not exceed 400 millions cubic feet per month; that is to say, when the natural discharge through the watershed cutting falls below 800 millions cubic feet per month, half the supply will be cut off and pumping started. This means that for about a week the discharge through the tunnel would be slightly less than what would have been the case if the water had been allowed to flow freely both day and night, but there would, however, be no difficulty in arranging to supply water by pumping during the day time and the small natural flow during night, in which case the irrigation would be slightly better off as the result of pumping, than would otherwise have been the case.

3. From the diagrams showing the level of the water in the Periyár lake from 1896 to 1908 the curves shown on sheet 3 have been prepared, and the data are given in tabular form at the end of this note. On the 1st of August 1896, it was assumed that the lake was full of water at the level 152 and from that date onwards the levels of each month have been determined by the addition of the water which actually came into the lake during the month and by the subtraction of the water, not as it was actually withdrawn for irrigation, but according to the normal demand already mentioned. Whenever the lake reached full supply level, any further addition during the month is assumed to have been surplussed. From the 1st of August 1896 to the 14th January 1899, the power scheme would have had no effect upon the lake, as there was an abundant supply of water. From the 14th of January to the end of the month, the lake would have emptied itself through the watershed cutting and would have fallen to the level of 112 on the 1st of February. Thence onwards pumping would be necessary and would continue till the end of April when the water-level would have fallen to 108·2 and the maximum lift against the pumps would be less than 4 feet. The rains of April filled the lake up again to the level of 122 and it would have been possible to have given full supply for irrigation at the beginning of June. In 1900, the full supply would cease on the 11th of January and pumping would have to be started on the 28th of that month and would continue till the 10th of June, the maximum lift against the pumps being about 7 feet. Up to this point the power supply scheme would have involved no interference whatever with the irrigation, and it would have contributed 400 millions cubic feet a month all through the hot weather. In 1900, however, it would not have been possible to start irrigation till the 16th of June, whilst if there had been no pumping, irrigation might have started some ten days earlier. Thence onward till February 1905, the normal irrigation demand would have been supplied without difficulty. On the 23rd February, however, the lake would have fallen to the level of 112 and pumping would have had to be started. The deficiency of water-supply in February would have been 270 millions cubic feet. Without pumping, water could have been let down on the 1st of June, but the lowering of the lake due to this cause would have delayed the opening of the irrigation season till the 15th of June. Thence onward to the end of the season, which proved to be a very bad one, the power scheme would have no effect upon the water-supply. On the 1st January 1906, pumping would have commenced and continued to the 1st of July, or for a period of six months, during which time the level in the lake would be lowered to 101·7 and the pumps would have had to lift the water to a maximum height of 11 feet. Not till the 20th July would it have been possible to give a full supply to irrigation. The water-supply in June would have been restricted to 400 millions cubic feet and the water-supply in July to 1,283 millions cubic feet. This is the most serious interference with the irrigation during the whole period of twelve years for which data are available. In 1907, pumping would have been started on the 15th of February and would have ceased on the 21st June. June would get a short supply, but thence onward till the 1st April 1908 there would be an ample supply of water for irrigation. The effect of pumping may perhaps be best summarised by stating the deficiency in the lake which would have to be made good on the 1st of June, before a full supply could be delivered. This is shown in the following tabular statement:—

| | |
|---|---|
| 1897 | ... |
| 1898 | ... |
| 1899 | ... |
| 1900 | 2,095 millions cubic feet. |
| 1901 | ... |
| 1902 | ... |
| 1903 | ... |
| 1904 | ... |
| 1905 | 1,597 millions cubic feet. |
| 1906 | 2,413 ,, |
| 1907 | 1,570 ,, |
| 1908 | ... |

From this it will be seen that only in four years out of twelve has any deficiency to be made good: but it is not so much the volume of the deficiency as the character of the early rainfall in June and July, which determines the effect upon irrigation. A large deficiency may be made good by a few days' heavy rainfall early in June, or a comparatively small deficiency may be prolonged into July by a late and feeble monsoon. The worst year hitherto experienced was 1906 when a large deficiency was combined with a late monsoon. In this year the power scheme would have seriously inconvenienced irrigation and the area under cultivation would probably have been restricted. There would have been sufficient water to have grown the first crop over the whole area, but it would have been a late crop and the second crop would probably have suffered owing to the lateness of the season and the limited supply of water visible in the lake throughout the year.

4. The diagrams show that the area drained by the Periyár river is insufficient to fully utilize the storage capacity created behind the Periyár dam. For a period of 34 months, the lake never surplussed at all, and in many years the quantity which will be surplussed under the new conditions is extremely small. It has been proposed to divert the Pambar river into the Periyár basin either with or without the creation of a large storage reservoir on the Pambar itself. Mr. Tressler, my Assistant, was employed on the preliminary surveys, and he points out that at a very small cost, part of the proposed scheme might be carried out by diverting the waters of the Kullar river into the Periyár basin. This would involve the construction of a small masonry dam and a comparatively shallow cutting through the watershed between the Periyár and the Kullar. In an appendix Mr. Tressler has explained what can be done and it seems to me that it will be quite practicable to build the dam across the Kullar completely closing it and to pass the waters coming down the river through a cutting in the watershed ridge sufficiently wide to carry off the maximum discharge of the Kullar. I think it may be accepted that this small diversion scheme which apparently can be carried out for about 1 lakh of rupees, would have added 2,500 millions cubic feet of water to the Periyár lake between October 1904 and August 1907. In ordinary years, such a contribution would be of no material value, but in years of deficient supply, it would be of great assistance. If this diversion is made at the cost of the power scheme, it would, I think, be a good deal more than a fair *quid pro quo* for the interference with irrigation which the power scheme would sometimes entail.

5. In this note I do not propose to deal in detail with the prospects of the hydro-electric scheme from a financial point of view. Providing for a pumping plant to be used in the watershed cutting and for the delivery of 20,000 horse power in Madura by a duplicated transmission line, the cost of the work will probably not exceed 65 lakhs of rupees, against which a total gross revenue of Rupees 13,75,000 might ultimately be expected. Assuming that the working expenses amount to as much as 10 per cent. on the gross cost of the works, there will be a balance of $7\frac{1}{4}$ lakhs of rupees from which a sinking fund can be provided and a substantial balance left as net revenue on the undertaking. At the outset it would be undesirable to instal a plant to deliver more than 10,000 horse power in Madura. This would interfere much less with irrigation than the proposal to supply 20,000 horse power and it would give time for further consideration of various schemes for supplementing the water-supply to the Periyár Project. With the 20,000 horse power fully developed and utilized in Madura, a very substantial contribution could be made towards the cost of improving the supply of water in the Periyár lake and this would probably justify the carrying out of the Pambar diversion, which, without power, would hardly be profitable.

A. Chatterton,
*Director of Industries.*

27*th March* 1909.

## *Data.*

Crest of watershed cutting (107·93) 108.

Bed fall, 1 foot per mile.

Bottom width of cutting, 35 feet.

Sides, vertical.

Maximum discharge, 3,160 millions cubic feet per month.

Daily discharge, 105,333,000 cubic feet.

Cubic feet per second, 1.220.

$$\text{Discharge} = C\,A\,\sqrt{rs}$$

| | | | |
|---|---|---|---|
| S = Slope of cutting. | $\sqrt{S}$ | = | ·0138 |
| A = Area .. | A | = | 35 d |
| r = H.M.D. .. | r | = | $\dfrac{35\,d}{2d+35}$ |

$$C = \frac{46{\cdot}1 + \dfrac{1{\cdot}811}{N} + \dfrac{{\cdot}00281}{S}}{1 + \left(41{\cdot}6 + \dfrac{{\cdot}00281}{S}\right)\dfrac{N}{\sqrt{r}}}$$

Co-efficient in Kutter's formula. N = 0·020

S = ·0001895

$$= \frac{41{\cdot}6 + \dfrac{1{\cdot}811}{0{\cdot}020} + \dfrac{{\cdot}00281}{{\cdot}0001895}}{1 + \left\{41{\cdot}6 + \dfrac{{\cdot}00281}{{\cdot}0001895}\right\}\dfrac{0{\cdot}020}{\sqrt{r}}}$$

$$= \frac{41{\cdot}6 + 95{\cdot}5 + 14{\cdot}83}{1 + (41{\cdot}6 + 14{\cdot}83)\,\dfrac{0{\cdot}020}{\sqrt{r}}}$$

When $r = 1$ .. .. $C = \dfrac{151{\cdot}9}{1 + (56{\cdot}43)\,{\cdot}020} = \dfrac{151{\cdot}9}{2{\cdot}1286}$

As corrected in the Chief Engineer's office.

$$\frac{41{\cdot}6 + \dfrac{1{\cdot}811}{0{\cdot}020} + \dfrac{{\cdot}00281}{{\cdot}0001894}}{1 + \left\{41{\cdot}6 + \dfrac{{\cdot}00281}{{\cdot}0001894}\right\}\dfrac{0{\cdot}020}{\sqrt{r}}}$$

$$\frac{41{\cdot}6 + 90{\cdot}55 + 14{\cdot}83}{1 + (41{\cdot}6 + 14{\cdot}83)\,\dfrac{0{\cdot}020}{\sqrt{r}}}$$

$$= \frac{146{\cdot}98}{1 + (56{\cdot}43)\,{\cdot}020} = \frac{146{\cdot}98}{2{\cdot}1286}$$

| r | C | As corrected in the Chief Engineer's office |
|---|---|---|
| 1 | = 73·5 | = 69·05 |
| 2 | = 84·5 | = 81·74 |
| 3 | = 91·9 | = 88·99 |
| 4 | = 97·1 | = 93·96 |
| 5 | = 101·1 | = 97·67 |
| 6 | = 104·0 | = 100·62 |
| 7 | = 106·4 | = 103·03 |
| 8 | = 108·5 | = 105·06 |
| 9 | = 110·3 | = 106·80 |

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## *Discharge of Watershed Cutting.*

| When D = | R | $\sqrt{r}$ | R (As corrected in the Chief Engineer's office) | $\sqrt{r}$ (As corrected) |
|---|---|---|---|---|
| 3 | = 2·56 | = 1·60 | = 2·56 | = 1·60 |
| 4 | = 3·18 | = 1·78 | = 3·25 | = 1·80 |
| 5 | = 3·89 | = 1·97 | = 3·89 | = 1·97 |
| 6 | = 4·43 | = 2·11 | = 4·47 | = 2·11 |
| 7 | = 5 | = 2·24 | = 5·00 | = 2·24 |
| 8 | = 5·49 | = 2·34 | = 5·49 | = 2·34 |
| 9 | = 5·94 | = 2·44 | = 5·94 | = 2·44 |
| 10 | = 6·37 | = 2·53 | = 6·37 | = 2·53 |
| 11 | = 6·76 | = 2·60 | = 6·76 | = 2·60 |
| 12 | = 7·12 | = 2·67 | = 7·1 | = 2·67 |

From curve Discharge. $C\,A\,\sqrt{rs}$

| D = | C = | C = (As corrected) |
|---|---|---|
| 3 | 89·5 | 86·46 |
| 4 | 92·9 | 90·60 |
| 5 | 96·5 | 93·70 |
| 6 | 98·9 | 96·01 |
| 7 | 101·1 | 97·98 |
| 8 | 102·5 | 99·40 |
| 9 | 103·8 | 100·74 |
| 10 | 104·9 | 101·88 |
| 11 | 105·9 | 102·73 |
| 12 | 106·7 | 103·55 |

| With ft. depth in | D = | cusecs. | D = (As corrected) | cusecs. |
|---|---|---|---|---|
| 3 | 89·5 × 105 × 1·6 × 0·0138 = | 213 | 86·46 × 105 × 1·6 × 0·0138 = | 200 |
| 4 | 92·9 × 140 × 1·78 × 0·0138 = | 318 | 90·60 × 140 × 1·8 × 0·0138 = | 315 |
| 5 | 96·5 × 175 × 1·97 × 0·0138 = | 459 | 93·70 × 175 × 1·97 × 0·0138 = | 446 |
| 6 | 98·9 × 210 × 2·11 × 0·0138 = | 605 | 96·01 × 210 × 2·11 × 0·0138 = | 585 |
| 7 | 101·1 × 245 × 2·24 × 0·0138 = | 766 | 97·98 × 245 × 2·24 × 0·0138 = | 742 |
| 8 | 102·5 × 280 × 2·34 × 0·0138 = | 926 | 99·40 × 280 × 2·34 × 0·0138 = | 902 |
| 9 | 103·8 × 315 × 2·44 × 0·0138 = | 1,100 | 100·74 × 315 × 2·44 × 0·0138 = | 1,069 |
| 10 | 104·9 × 350 × 2·53 × 0·0138 = | 1,282 | 101·88 × 350 × 2·53 × 0·0138 = | 1,245 |

*Time required to empty the lake through the watershed cutting assuming no inflow to the lake.*

| Level. | Capacity. | Difference. | Water level lowered in days. | Water level lowered in days (column 4) as corrected in the Chief Engineer's office. |
|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 |
| 109 .. .. .. .. .. .. .. .. | 5,847 | | | |
| 110 .. .. .. .. .. .. .. .. | 6,003 | 156 | .. | .. |
| 111 .. .. .. .. .. .. .. .. | 6,163 | 160 | .. | .. |
| 112 .. .. .. .. .. .. .. .. | 6,324 | 161 | 6·950 | 7·235 |
| 113 .. .. .. .. .. .. .. .. | 6,484 | 160 | 4·740 | 4·866 |
| 114 .. .. .. .. .. .. .. .. | 6,652 | 168 | 3·658 | 3·771 |
| 115 .. .. .. .. .. .. .. .. | 6,819 | 167 | 2·820 | 2·912 |
| 116 .. .. .. .. .. .. .. .. | 6,999 | 180 | 2·462 | 2·534 |
| 117 .. .. .. .. .. .. .. .. | 7,179 | 180 | 1·895 | 2·113 |
| 118 .. .. .. .. .. .. .. .. | 7,359 | 180 | 1·750 | 1·800 |
| Total .. | .. | 1,512 | 24·275 to 111<br>17·325 to 112 | 25·231 to 111<br>17·996 to 112 |

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*Daily discharges of watershed cutting at various depths.*

| Depth in feet. | Discharge in millions of cubic feet per day. | Average. | Water level. | As corrected in the Chief Engineer's office. | | |
|---|---|---|---|---|---|---|
| | | | | Discharge in millions of cubic feet per day (col. 2.) | Average (col. 3). | Water level (col. 4). |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 3 .. .. .. .. .. .. | 18·4 | 23·15 | 111 | 17·28 | 22·25 | 111 |
| 4 .. .. .. .. .. .. | 27·9 | 33·75 | 112 | 27·22 | 32·88 | 112 |
| 5 .. .. .. .. .. .. | 39·6 | 45·95 | 113 | 38·53 | 44·54 | 113 |
| 6 .. .. .. .. .. .. | 52·3 | 59·25 | 114 | 50·54 | 57·33 | 114 |
| 7 .. .. .. .. .. .. | 66·2 | 73·10 | 115 | 64·11 | 71·02 | 115 |
| 8 .. .. .. .. .. .. | 80·0 | 87·50 | 116 | 77·93 | 85·15 | 116 |
| 9 .. .. .. .. .. .. | 95·0 | 102·90 | 117 | 92·36 | 99·97 | 117 |
| 10 .. .. .. .. .. .. | 110·8 | | 118 | 107·57 | | 118 |
| The lake runs off through the watershed cutting from a level of 118 to 112 in 17·325 days. | | | | The lake runs off through the watershed cutting from a level of 118 to 112 in 17·99 days. | | |

*Levels at which water would have been maintained in the lake under the conditions detailed in the Note.*

| Date. | Water level. | Contents of lake. | Addition during month. | Discharge during month. |
|---|---|---|---|---|
| 1st August lake surplussed. | | | | |
| *1896.* | | | | |
| 1st August | 152 | 15,662 | 5,851 | 3,000 |
| 1st September | 152 | 15,662 | 1,349 | 3,160 |
| 1st October | 146 | 13,851 | 3,452 | 3,160 |
| 1st November | 147 | 14,143 | 7,720 | 3,160 |
| 1st December | 152 | 15,662 | 3,932 | 3,160 |
| *1897.* | | | | |
| 1st January | 152 | 15,662 | 736 | 3,160 |
| 1st February | 144 | 13,238 | 756 | 1,850 |
| 1st March | 139 | 12,144 | 487 | 400 |
| 1st April | 140 | 12,231 | 370 | 400 |
| 1st May | 140 | 12,201 | 162 | 400 |
| 1st June | 139 | 11,963 | 8,204 | 2,500 |
| 1st July | 152 | 15,662 | 6,292 | 2,500 |
| 1st August | 152 | 15,662 | 9,974 | 3,000 |
| 1st September | 152 | 15,662 | 2,047 | 3,160 |
| 1st October | 148 | 14,549 | 2,479 | 3,160 |
| 1st November | 146 | 13,868 | 4,268 | 3,160 |
| 1st December | 150 | 14,976 | 977 | 3,160 |
| *1898.* | | | | |
| 1st January | 142 | 12,793 | 611 | 3,160 |
| 1st February | 132 | 10,244 | 901 | 1,850 |
| 1st March | 127 | 9,295 | 188 | 400 |
| 1st April | 126 | 9,083 | 118 | 400 |
| 1st May | 125 | 8,801 | 373 | 400 |
| 1st June | 125 | 8,774 | 2,937 | 2,500 |
| 1st July | 127 | 9,211 | 3,984 | 2,500 |
| 1st August | 134 | 10,595 | 1,263 | 3,060 |
| 1st September | 126 | 8,958 | 1,059 | 3,160 |
| 1st October | 115 | 6,867 | 5,120 | 3,160 |
| 1st November | 125 | 8,817 | 3,728 | 3,160 |
| 1st December | 128 | 9,385 | 1,719 | 3,160 |
| *1899.* | | | | |
| 1st January | 121 | 7,944 | 800 | 2,430 |
| Full supply ceases 14th January. | | | | |
| 1st February | 112 | 6,324 | 158 | 400 |
| Pumping commences. | | | | |
| 1st March | 110·5 | 6,082 | 49 | 400 |
| 1st April | 108·2 | 5,731 | 2,945 | 400 |
| Pumping ceases at the end of April. | | | | |
| 1st May | 122 | 8,276 | 482 | 400 |
| 1st June | 123 | 8,358 | 4,300 | 2,500 |
| 1st July | 131 | 10,158 | 8,207 | 2,500 |
| 1st August | 152 | 15,662 | 1,128 | 3,000 |
| 1st September | 145 | 13,790 | 742 | 3,160 |
| 1st October | 137 | 11,372 | 3,518 | 3,160 |
| 1st November | 138 | 11,730 | 1,471 | 3,160 |
| 1st December | 131 | 10,041 | 1,467 | 3,160 |
| *1900.* | | | | |
| 1st January | 123 | 8,348 | 212 | 2,127 |
| Full supply ceases 11th January. | | | | |
| Pumping commences 28th January. | | | | |
| 1st February | 111·6 | 6,271 | 50 | 400 |
| 1st March | 109·5 | 5,921 | 20 | 400 |
| 1st April | 107 | 5,541 | 187 | 400 |
| 1st May | 105·7 | 5,328 | 346 | 400 |
| 1st June | 105·2 | 5,264 | 3,159 | 1,450 |
| Pumping ceases 10th June. | | | | |
| Water let down 16th June. | | | | |
| 1st July | 121 | 7,973 | 9,325 | 2,500 |
| 1st August | 149 | 14,798 | 13,002 | 3,000 |
| 1st September | 152 | 15,662 | 2,448 | 3,160 |
| 1st October | 150 | 14,950 | 2,589 | 3,160 |
| 1st November | 148 | 14,379 | 3,922 | 3,160 |
| 1st December | 150 | 15,141 | 1,702 | 3,160 |

Levels at which water would have been maintained in the lake under the conditions, etc.—*cont.*

| Date. | Water level. | Contents of lake. | Addition during month. | Discharge during month. |
|---|---|---|---|---|
| *1901.* | | | | |
| 1st January | 145 | 13,683 | 1,220 | 3,160 |
| 1st February | 138 | 11,743 | 493 | 1,850 |
| 1st March | 133 | 10,386 | 1,232 | 400 |
| 1st April | 136 | 11,218 | 540 | 400 |
| 1st May | 137 | 11,358 | 188 | 400 |
| 1st June | 135 | 11,146 | 4,080 | 2,500 |
| 1st July | 142 | 12,726 | 7,666 | 2,500 |
| 1st August | 152 | 15,662 | 3,257 | 3,000 |
| 1st September | 152 | 15,662 | 1,219 | 3,160 |
| 1st October | 146 | 13,721 | 2,591 | 3,160 |
| 1st November | 143 | 13,152 | 6,036 | 3,160 |
| 1st December | 152 | 15,662 | 1,450 | 3,160 |
| *1902.* | | | | |
| 1st January | 146 | 13,952 | 2,467 | 3,160 |
| 1st February | 144 | 13,259 | 264 | 1,850 |
| 1st March | 138 | 11,673 | 22 | 400 |
| 1st April | 136 | 11,295 | 151 | 400 |
| 1st May | 135 | 11,046 | 75 | 400 |
| 1st June | 134 | 10,721 | 58 | 2,500 |
| 1st July | 123 | 8,279 | 5,814 | 2,500 |
| 1st August | 137 | 11,593 | 1,591 | 3,000 |
| 1st September | 131 | 10,184 | 3,324 | 3,160 |
| 1st October | 132 | 10,348 | 8,323 | 3,160 |
| 1st November | 152 | 15,511 | 7,461 | 3,160 |
| 1st December | 152 | 15,662 | 6,872 | 3,160 |
| *1903.* | | | | |
| 1st January | 152 | 15,662 | 551 | 3,160 |
| 1st February | 143 | 13,053 | 153 | 1,850 |
| 1st March | 138 | 11,356 | 16 | 400 |
| 1st April | 135 | 10,956 | 23 | 400 |
| 1st May | 133 | 10,579 | 280 | 400 |
| 1st June | 133 | 10,459 | 682 | 2,500 |
| 1st July | 125 | 8,641 | 9,167 | 2,500 |
| 1st August | 151 | 15,308 | 4,909 | 3,060 |
| 1st September | 152 | 15,662 | 3,411 | 3,160 |
| 1st October | 152 | 15,662 | 4,528 | 3,160 |
| 1st November | 152 | 15,662 | 1,722 | 3,160 |
| 1st December | 147 | 14,224 | 5,939 | 3,160 |
| *1904.* | | | | |
| 1st January | 152 | 15,662 | 959 | 3,160 |
| 1st February | 145 | 13,461 | 183 | 1,850 |
| 1st March | 138 | 11,794 | 9 | 400 |
| 1st April | 137 | 11,403 | 93 | 400 |
| 1st May | 135 | 11,096 | 134 | 400 |
| 1st June | 134 | 10,830 | 10,110 | 2,500 |
| 1st July | 152 | 15,662 | 9,330 | 2,500 |
| 1st August | 152 | 15,662 | 4,341 | 3,000 |
| 1st September | 152 | 15,662 | 1,400 | 3,160 |
| 1st October | 146 | 13,902 | 4,291 | 3,160 |
| 1st November | 150 | 15,033 | 1,108 | 3,160 |
| 1st December | 143 | 12,981 | 460 | 3,160 |
| *1905.* | | | | |
| 1st January | 132 | 10,281 | 200 | 3,160 |
| 1st February | 118 | 7,321 | 502 | 1,580 |
| Pumping commences 23rd February 1905. | | | | |
| 1st March | 109·6 | 5,943 | 17 | 400 |
| 1st April | 107·2 | 5,560 | 554 | 400 |
| 1st May | 108·1 | 5,714 | 448 | 400 |
| 1st June | 108·5 | 5,762 | 3,484 | 1,450 |
| Water let down 15th June 1905. | | | | |
| 1st July | 120 | 7,796 | 3,672 | 2,500 |
| 1st August | 126 | 8,968 | 1,138 | 3,000 |
| 1st September | 117 | 7,106 | 2,053 | 1,800<br>891 |
| Full supply ceases 18th September. | | | | |
| 1st October | 113 | 6,468 | 4.575 | 135 |
| | 5th to 10th—Pumping | .. | .. | 80 |
| | 11th—Full supply | .. | .. | 2,107 |

Levels at which water would have been maintained in the lake under the conditions, etc.—*cont.*

| Date. | Water level. | Contents of lake. | Addition during month. | Discharge during month. | |
|---|---|---|---|---|---|
| *1905—cont.* | | | | | |
| 1st November .. .. .. .. .. .. .. | 125 | 8,721 | 2,566 | 3,160 | |
| 1st December .. .. .. .. .. .. .. | 122 | 8,127 | 700 | 1,468 | |
| Full supply ceases 15th December .. .. .. | | | | 1,035 | |
| *1906.* | | | | | |
| 1st January .. .. .. .. .. .. .. | 112 | 6,324 | 221 | 400 | |
| Pumping commences. | | | | | |
| 1st February .. .. .. .. .. .. .. | 110.9 | 6,145 | 40 | 400 | |
| 1st March .. .. .. .. .. .. .. | 108·6 | 5,785 | 88 | 400 | |
| 1st April .. .. .. .. .. .. .. | 106·5 | 5,473 | 45 | 400 | |
| 1st May .. .. .. .. .. .. .. | 104·3 | 5,118 | 222 | 400 | |
| 1st June .. .. .. .. .. .. .. | 103·1 | 4,940 | .. | 200 } | |
| 15th ,, .. .. .. .. .. .. .. | 101·7 | 4,740 | 958 | 200 } | |
| 1st July .. .. .. .. .. .. .. | 106·7 | 5,498 | 1,026 | 200 } | |
| 15th ,, .. .. .. .. .. .. .. | 112·0 | 6,324 | 1,285 | 250 } | |
| Pumping ceases. | | | | | |
| 20th July .. .. .. .. .. .. .. | 118 | 7,359 | 1,998 | 833 } | |
| 1st August .. .. .. .. .. .. .. | 124 | 8,524 | 6,656 | 3,000 | |
| 1st September .. .. .. .. .. .. .. | 139 | 12,180 | 1,371 | 3,160 | |
| 1st October .. .. .. .. .. .. .. | 132 | 10,391 | 2,942 | 3,160 | |
| 1st November .. .. .. .. .. .. .. | 131 | 10,173 | 3,966 | 3,160 | |
| 1st December .. .. .. .. .. .. .. | 135 | 10,979 | 1,804 | 3,160 | |
| *1907.* | | | | | |
| 1st January .. .. .. .. .. .. .. | 129 | 9,623 | 771 | 3,160 | |
| 1st February .. .. .. .. .. .. .. | 117·5 | 7,234 | 73 | 983 } | |
| 15th ,, .. .. .. .. .. .. .. | 112 | 6,324 | .. | 200 } | |
| Pumping commences. | | | | | |
| 1st March .. .. .. .. .. .. .. | 111 | 6,124 | 202 | 400 | |
| 1st April .. .. .. .. .. .. .. | 109 | 5,926 | 595 | 400 | |
| 1st May .. .. .. .. .. .. .. | 111 | 6,121 | 70 | 400 | |
| 1st June .. .. .. .. .. .. .. | 108·6 | 5,791 | .. | 133 } | |
| 11th ,, .. .. .. .. .. .. .. | 107·8 | 5,658 | 801 | 133 } | 901 |
| 21st ,, .. .. .. .. .. .. .. | 112·0 | 6,324 | 1,310 | 635 } | |
| Pumping ceases. | | | | | |
| 1st July .. .. .. .. .. .. .. | 116 | 6,999 | 1,960 | 1,600 } | 2,500 |
| 20th ,, .. .. .. .. .. .. .. | 118 | 7,359 | 3,382 | 900 } | |
| 1st August .. .. .. .. .. .. .. | 130 | 9,841 | 11,543 | 3,000 | |
| 1st September .. .. .. .. .. .. .. | 152 | 15,662 | 1,640 | 3,160 | |
| 1st October .. .. .. .. .. .. .. | 147 | 14,142 | 5,661 | 3,160 | |
| 1st November .. .. .. .. .. .. .. | 152 | 15,662 | 9,321 | 3,160 | |
| 1st December .. .. .. .. .. .. .. | 152 | 15,662 | 1,795 | 3,160 | |
| *1908.* | | | | | |
| 1st January .. .. .. .. .. .. .. | 147 | 14,297 | 1,417 | 3,160 | |
| 1st February .. .. .. .. .. .. .. | 141 | 12,554 | 376 | 1,850 | |
| 1st March .. .. .. .. .. .. .. | 135 | 11,080 | 174 | 400 | |
| 1st April .. .. .. .. .. .. .. | 134 | 10,854 | .. | .. | |

*27th March* 1909.

A. CHATTERTON,
*Director of Industries.*

## Appendix A

### *Note on the Kullar Reservoir by Mr. K. T. B. Tressler.*

The catchment area of the Kullar has been partially surveyed (G.O., No. 226 I. of 1908), and the portion yet remaining can be determined with sufficient accuracy. On the northern side, the watershed of the Kullar consists of a range of hills running parallel with the Periyár lake. These hills are visible from most of the survey stations established by the Periyár-Pambiyar Survey Party, and their position can therefore be very approximately fixed. The watershed follows this range until it meets a cross range at a point about one mile short of the "Bleak House" camp, and afterwards bears to the south, turning westward again close to "Billingsgate" camp, and approximately following the path to "Jericho". As the position of these camps has been fixed on the map by the investigation party, the tracing of the watershed with reference to them involves very little error indeed.

The area thus defined amounts to about 12 square miles (actually 12·22 square miles).

2. In the appended table are shown the rainfall at Periyár and Tekkadi, and the discharge of the Periyár over a series of years. The earlier figures are taken from Mackenzie's "History of the Periyár Project," the discharges being calculated from a table therein given of the average monthly depths of water on a weir, by means of another table showing the relation of these depths to the discharge. The latter table does not appear to be entirely accurate, nor can the former be accepted without reservations. It is hard, for instance, to reconcile the small discharge during 1890—1901 with the statement that, during this year "the whole work was constantly submerged and interrupted by floods"—a circumstance only possible when the discharge exceeded 2,000 cusecs. The discharges calculated on such data can only therefore be treated as approximate, but as, throughout this period, they always largely exceeded the normal demand, their relative accuracy does not affect the main question.

3. Taking the table as a whole, however, it will at once be seen that there is no direct connection between the river discharge and the rainfall at the dam. The river, in fact, depends for its supply on an area having a distribution of rainfall very different from that at the dam. The discharge from the Kullar catchment, on the other hand, situated as it is at no great distance from the dam, would be more or less proportionate to the rainfall there recorded. The diversion of the Kullar would thus add to the catchment of the Periyár, an area having an entirely different distribution of rainfall. The importance of this point is made clearer by considering the relation between the rainfall and discharge in the case of the two successions of bad years which have so far occurred. In the bad period 1899—1901, the river discharge over the two years was 36 per cent. under normal, whereas the rainfall at the Periyár dam was only 2 per cent. less than the average, and in 1905—1907, when there was an average deficit of 40 per cent. in the discharge, the rainfall was about 1 per cent. over normal. Records then tend to show that this supplementary supply is unaffected when the main source fails—a circumstance the value of which needs no special emphasis.

4. The table discloses another fact also. It will be seen that the rainfall at the dam is persistently higher than that at Tekkadi. The average for the former station is slightly over 80 inches, whereas that for the latter is only 73. This phenomenon is easily explained: Tekkadi is situated at the extreme edge of the plateau: in the south-west monsoon it receives only that moisture which has not already been precipitated in its passage across the mountains—a quantity very much less than that intercepted by ranges further to the south-west. The rainfall at the dam is therefore most largely in excess of that at Tekkadi during the south-west monsoon: and though this excess may be partially balanced by a somewhat greater precipitation at that station during the north-east monsoon, yet, on the whole—as the figures show—there is a distinct balance in favour of the more southerly station. Moreover, as it is the north-east monsoon that usually fails, it is just in such times of partial failure that the advantage becomes most pronounced.

5. Extending the argument, there is reason to believe that the rainfall at the Kullar is in like proportion greater than that at the dam, and the few observations which have been made on the Pambiyar, endorse this opinion. It must be remembered that, not 20 miles away from the dam, the rainfall often reaches 200 inches, so that there would be nothing remarkable in its being 90 or 100 on the Kullar, and no one who has spent some time on the Periyár, and seen the hills on the south capped, day after day, with heavy clouds in spite of the clear sky above him, will question the accuracy of the assumption.

6. Now the periods during which the Kullar supply would have been most necessary, occurred in 1899—1901 and 1904—1907. In the latter case, the deficiency of discharge was very much greater than in the former, so that it is sufficient if we confine our attention to this (1904—1907) period, constituting, as it does, the worst period hitherto recorded. From August 1904 till July 1907, the lake, under the assumed conditions of demand, would have failed to surplus, and any water run into it during this period, could have been stored.

7. In these 34 months the average rainfall at the dam was about 20 per cent. in excess of that at Tekkadi, and it is reasonable—seeing that the Kullar catchment lies rather further south of the Periyár than Tekkadi is north of it—to suppose that the rainfall there is greater than that at the dam in at least the same proportion. The reality of an excess on the Kullar can scarcely be disputed, but it may perhaps be urged that, in the absence of recorded observations on that area, a 20 per cent. allowance on the Periyár figures is excessive. An increase of 10 per cent., however,—a figure representing the average difference between the Periyár and Tekkadi rainfall—may be taken as a conservative estimate of the probable rainfall in the Kullar catchment.

8. Now between 26th August 1904 (when the lake ceased to surplus) and 15th June 1907 (when, without power, irrigation could have been begun), the rainfall at the dam was 203½ inches, which, on our assumption, would represent 224 inches on the Kullar. Mackenzie in the "History of the Periyár Project" gives the percentage run-off as five-ninths for this district, and so, assuming the catchment to be 12 square miles, the total quantity of useful water which this river could have furnished during the worst period on record, works out at 3,470,000,000 cubic feet—an amount practically equivalent to that assumed to have been abstracted from the lake for purely power purposes in this interval.

9. To divert this water into the Periyár lake, it would be necessary to construct a dam across the Kullar. Since the lowest point on the watershed separating the two rivers is about 55 feet above the bed of the Kullar at the site of the proposed dam, a dam of this height would effect the diversion without any cutting down of the watershed. Lowering the watershed ridge would involve blasting, but the stone so obtained could be utilised in the construction of the dam, the necessary height of which would naturally be considerably reduced by the excavation of a channel through the ridge. The rates paid on the Periyár dam for blasting were Rs. 12 per 100 cubic feet, and those for uncoursed rubble masonry Rs. 30 per 100 cubic feet. It thus appears that the most economical combination consists of a cutting 20 feet wide by 15 feet deep to carry 10 feet of water, and a dam 43 feet high. This would necessitate the removal of about 300,000 cubic feet of rock by blasting, costing, at the Periyár rates, Rs. 36,000, and the construction of a dam 43 feet high, containing about 140,000 cubic feet of masonry, and costing Rs. 42,000. Total, Rs. 78,000. These figures do not include the cost of machinery and supervision, but a lakh of rupees should be sufficient to cover the cost of the work.

10. It is to be noted that the proposed dam requires no escape, since the watershed cutting constitutes the surplus weir. Under the present proposal, the water of the Kullar is completely diverted, but no provision is made for storage. As storage on the Kullar could only be effected at a comparatively high cost, and as it is considered that the supply to be obtained from the diversion would amply compensate irrigation for any water which may have been utilised for power purposes, it seems unnecessary in the present note to enter into the details of this question.

K. T. B. Tressler.

*Table I showing the Rainfall and Discharge.*

| Year. | Rainfall at | | Discharge of Periyár. | Percentage excess. | | As corrected in the Chief Engineer's office. | |
|---|---|---|---|---|---|---|---|
| | Tekkadi. | Periyár. | | Rainfall. | Discharge. | Discharge of Periyár (col. 4). | Percentage excess. Discharge (col. 6). |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| 1888–1889 | .. | 104·75 | .. | .. | .. | .. | .. |
| 1889–1890 | .. | 93·96 | 52,690 | + 17 | + 46 | 52,690 | + 46 |
| 1890–1891 | .. | 57·70 | 32,580 | — 28 | — 9 | 32,580 | — 9 |
| 1891–1892 | .. | 67·40 | 52,420 | — 16 | + 45 | 52,420 | + 45 |
| 1892–1893 | .. | 62·28 | 44,550 | — 22 | + 24 | 44,550 | + 24 |
| 1893–1894 | .. | 63·13 | 44,140 | — 21 | + 23 | 44,140 | + 23 |
| 1894–1895 | .. | 70·44 | 46,920 | — 11 | + 30 | 46,920 | + 30 |
| 1895–1896 | .. | 85·95 | .. | + 4 | .. | .. | .. |
| 1896–1897 | .. | .. | .. | .. | .. | 41,702 | + 16 |
| 1897–1898 | 94·30 | .. | 41,738 | + 37 | + 16 | 36,478 | + 2 |
| 1898–1899 | 71·43 | .. | 36,478 | — 3 | + 2 | 21,313 | — 41 |
| 1899–1900 | 63·60 | .. | 21,413 | — 13 | — 41 | 24,549 | — 32 |
| 1900–1901 | 78·85 | .. | 24,549 | + 9 | — 32 | 39,632 | + 10 |
| 1901–1902 | 61·00 | 73·00 | 39,632 | — 9 | + 10 | 29,785 | — 17 |
| 1902–1903 | 72·75 | 72·05 | 29,785 | — 10 | — 17 | 34,363 | — 5 |
| 1903–1904 | 75·70 | 78·66 | 34,394 | — 2 | — 5 | 31,816 | — 12 |
| 1904–1905 | 68·25 | 90·15 | 31,736 | + 12 | — 12 | 31,992 | — 12 |
| 1905–1906 | 65·55 | 75·95 | 19,542 | — 5 | — 46 | 19,543 | — 46 |
| 1906–1907 | 69·45 | 85·70 | 23,324 | + 7 | — 35 | 23,324 | — 35 |
| 1907–1908 | 85·46 | 121·48 | 40,061 | + 51 | + 11 | 40,051 | + 11 |

## ANNEXURE B.

### Note by the Chief Engineer for Irrigation, dated 11th June 1909.

Mr. Chatterton first submitted a power scheme which required an average discharge throughout the year of 110 cusecs and in connection with this, it was shown that it was impracticable to guarantee more than 50 cusecs without reserving water at the expense of irrigation for the use of power during the closure months and this was considered to be inadmissible. Mr. Chatterton has now submitted a modified scheme requiring an average discharge of 315 cusecs for 12 hours a day or 157 cusecs for 24 hours, and proposes to get over the difficulty of interference with irrigation as follows:—

(*a*) By pumping water from below the offtake level when water is not otherwise available, which suggestion, I may mention, was made by Mr. Garrett in connection with his original scheme.

(*b*) By compensating for the water thus abstracted from the lake by diverting into the Periyár reservoir an additional catchment area of 12 square miles from the Kullar river.

2. I do not propose in this note to make any attempt to criticise in detail Mr. Chatterton's proposals as regards the power plant, but will merely remark that the figures of cost given are only approximate ones and in comparison with those of Major de Lotbiniere in connection with Mr. Garrett's scheme, appear to be low. I shall therefore only deal with the scheme as regards the supply of water and its possible effect upon Periyár irrigation.

3. The tables prepared by Mr. Tressler, though based upon data supplied by the Irrigation Chief Engineer's office, are not in the form usually adopted in that office and I have therefore had a fresh set prepared in the latter form, but on the same data.

The demands for irrigation amount to 25,650 millions cubic feet for a period of ten months and allow for as large a discharge as it is normally possible to utilise with the existing tunnel capacity, making no allowance for rainfall on the irrigated tract. It may be pointed out that these demands are much in excess of what it has hitherto been found possible to utilise, the maximum supply used up to date in any one season being 21,982 millions cubic feet in 1901–1902, which is equivalent to 82 per cent. of the average discharge of the Periyár for the past eleven years, 31,212 millions cubic feet. It is further pointed out that as the river supply varies from a maximum of 41,702 millions cubic feet to a minimum of 19,543 millions cubic feet and as in at least two consecutive years, there may occur a short supply in which the lake does not fill, the ultimate irrigable area must, even if the tunnel is enlarged, be limited to some extent by the minimum supply in the river. Proposals like the present ones which provide for a normal supply 30 per cent. in excess of this minimum, may therefore be reasonably assumed to be likely to suit such altered conditions. In other words, although no draw-off tables have at present been worked out with an enlarged tunnel, it may be for the present assumed that 25,650 millions cubic feet is as much of the available supply of the river as will on the average be ever utilised with the present catchment area even with an enlarged tunnel. In the event of any material increase to the catchment area, such as would be obtained by the diversion of the Pambiyar, conditions would, of course, be materially improved both for irrigation and power.

4. As regards Mr. Chatterton's suggestion (*b*), it may be remarked that the present catchment of the Periyár is estimated to be 305 square miles and the addition of 12 square miles is equivalent to an increase in area of 4 per cent., and from the nature of the Kullar catchment, it will not be unreasonable to assume that a corresponding increase of 4 per cent. in the river supply will result.

The calculated effect of the Kullar diversion is based upon this assumption and this effect, as well as the effect of the pumping scheme, is shown in the following analysis of the tables for each year from 1896-97 to 1907-1908 :—

*1896–97.*—No effect. Supplies ample.

*1897–98.*—No effect. Supplies ample.

*1898–99.*—No ill-effect on irrigation. Supplies deficient January and February; that in January would have been saved by Kullar.

*1899–1900.*—No effect on irrigation in June owing to lake receiving supplies in April 1899. Supplies deficient January 1900, February 1900. No ill-effect. Kullar would have supplied January deficiency.

*1900–1901.*—Reservoir had to fill up in June from 105·5 to 112 = 1,023 millions cubic feet. The lake diagram shows this would have taken twelve days to June 24th. Ample water at the end of the year, really no effect on irrigation, but more would have run to waste.

*1901–1902.*—Supplies ample. No effect.

*1902–1903.*—Supplies ample. No effect.

*1903–1904.*—Supplies ample. No effect.

*1904–1905.*—No ill-effect. Slight defect in February. Would have been saved by Kullar.

*1905–1906.*—In this year there would have been without power about 1,000 millions cubic feet available on 1st June; with power there was none; no supply except the 13·3 millions cubic feet used daily for power, would have been available till June 20th when supplies were received. The supplies were generally deficient throughout the year, the river supply being 19,543 millions cubic feet. Four per cent. on this (780 millions) due to the Kullar would probably have been more useful than the 1,000 millions run out of the lake in the first part of June, before anyone knew supplies would be short.

*1906–1907.*—The year was started with lake empty; with power it would have started with a deficiency of 1,400 millions to be made up. The lake diagram shows conclusively that water would not rise to 112 until July 20th; however, actual supplies were little if anything more than would be used for power, as, at the actual water levels throughout 1st June—20th July, the cutting can only discharge a small supply, probably not more than 1,000 or 1,100 millions against 660 with power and there would have been a certain amount stored in the tanks to balance the difference. Deficiencies are shown in January and February amounting to 1,757 millions, but the supply from the Kullar 4 per cent. on 23,323 = 933 millions will make up fully for half of this. The deficiency is not due to power and irrigation benefits.

6,324 — 4,940 = 1,384.

*1907–1908.*—Without power there would have been on June 1st, 940 millions available. With power there would have been a deficiency and irrigation would have had to wait till the lake rose on June 15th; there was ample water for the rest of the year.

The irrigation demands are placed very high. No account being taken of the rainfall on the ayacut, it is more than probable that this and the Kullar supplies would have enabled the reservoir to start fairly well in 1905–1906.

The project would have benefited distinctly by the Kullar extension scheme in 1898–99, 1899–1900 and 1904–1905. I think there is as much in favour of, as against, the power scheme in the bad years 1905–1906 and 1906–1907. In the other years, the proposal has no effect on irrigation.

Mr. Tressler's calculations have been checked and found generally correct; also his tables show water levels very approximately the same as our independent calculations.

5. The general conclusions from the above are that the addition of the Kullar catchment will compensate for the interference with irrigation resulting from the power scheme which interference is usually limited to throwing back the date of opening the tunnel for irrigation.

As a matter of fact, even this interference is not very material, as it is at present usual, when the reservoir is low at the end of a season, to wait until the south-west monsoon bursts before opening the tunnel, and as soon as the monsoon does burst, the lake usually fills up fairly quickly to a sufficient height.

"It is to be noted that without the addition of the Kullar the available supply in the lake would have been reduced in each of the years 1905–1906, 1906–1907 and 1907–1908 by the water drawn off in March, April and May 1905, 1906 and 1907, respectively, and that this interference would not be justifiable.

6. It is admitted that the scheme involves passing water through the tunnel during this period when under existing conditions it is usually closed for irrigation.

While, however, the Chief Engineer for Irrigation is not prepared without further evidence to agree with Mr. Chatterton's original expectations that this water will be utilised for crops, such as sugarcane, etc., and a higher water-rate than usual realized therefrom, experience in the Madras Presidency has shown that when a perennial supply of water is available, it is invariably utilised by the ryots for irrigation and it is therefore fair to assume that this supply will not be wasted.

7. On the whole, the Chief Engineer for Irrigation is of opinion that the scheme on the lines now proposed by Mr. Chatterton is unobjectionable as regards its possible effect upon irrigation, more especially, as it involves no guarantee on the part of Government to maintain the supply of water through the tunnel for power.

C. A. Smith,
*Chief Engineer for Irrigation.*

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ENCLOSURE.

*Periyar Power Scheme Tables.*

| Month. | Total discharge of Periyár. | Balance in reservoir on the first of the month. | Total supply available. | Demand. | Balance in reservoir at the end of the month. | Lake level corresponding. | Surplus or deficiency. |
|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| | | | *1896–1897.* | | | | |
| August | 5,851 | 15,662 | 21,513 | 3,000 | 15,662 | 152 | + 2,851 |
| September | 1,349 | 15,662 | 17,011 | 3,160 | 13,851 | 146 | .. |
| October | 3,452 | 13,851 | 17,303 | 3,160 | 14,143 | 147 | .. |
| November | 7,720 | 14,143 | 21,863 | 3,160 | 15,662 | 152 | + 3,041 |
| December | 3,932 | 15,662 | 19,594 | 3,160 | 15,662 | 152 | + 772 |
| January | 736 | 15,662 | 16,398 | 3,160 | 13,238 | 144 | .. |
| February | 756 | 13,238 | 13,994 | 1,850 | 12,144 | 140 | .. |
| March | 487 | 12,144 | 12,631 | 400 | 12,231 | 140 | .. |
| April | 370 | 12,231 | 12,601 | 400 | 12,201 | 140 | .. |
| May | 162 | 12,201 | 12,363 | 400 | 11,963 | 139 | .. |
| | | | *1897–1898.* | | | | |
| June | 8,204 | 11,963 | 20,167 | 2,500 | 15,662 | 152 | + 2,005 |
| July | 6,292 | 15,662 | 21,954 | 2,500 | 15,662 | 152 | + 3,792 |
| August | 9,974 | 15,662 | 25,636 | 3,000 | 15,662 | 152 | + 6,974 |
| September | 2,047 | 15,662 | 17,709 | 3,160 | 14,549 | 148 | .. |
| October | 2,479 | 14,549 | 17,028 | 3,160 | 13,868 | 146 | .. |
| November | 4,268 | 13,868 | 18,136 | 3,160 | 14,976 | 150 | .. |
| December | 977 | 14,976 | 15,953 | 3,160 | 12,793 | 142 | .. |
| January | 611 | 12,793 | 13,404 | 3,160 | 10,244 | 132 | .. |
| February | 901 | 10,244 | 11,145 | 1,850 | 9,295 | 127 | .. |
| March | 188 | 9,295 | 9,483 | 400 | 9,083 | 126 | .. |
| April | 118 | 9,083 | 9,201 | 400 | 8,801 | 125 | .. |
| May | 373 | 8,801 | 9,174 | 400 | 8,774 | 125 | .. |
| | | | *1898–1899.* | | | | |
| June | 2,937 | 8,774 | 11,711 | 2,500 | 9,211 | 127 | .. |
| July | 3,984 | 9,211 | 13,195 | 2,500 | 10,695 | 134 | .. |
| August | 1,263 | 10,695 | 11,958 | 3,000 | 8,958 | 126 | .. |
| September | 1,059 | 8,958 | 10,017 | 3,160 | 6,857 | 115 | .. |
| October | 5,120 | 6,857 | 11,977 | 3,160 | 8,817 | 125 | .. |
| November | 3,728 | 8,817 | 12,545 | 3,160 | 9,385 | 128 | .. |
| December | 1,719 | 9,385 | 11,104 | 3,160 | 7,944 | 121 | .. |
| January | 800 | 7,944 | 8,744 | 2,420 | 6,324 | 112 | — 740 |
| February | 158 | 6,324 | 6,482 | 400 | 6,082 | 110·5 | — 1,450* |
| March | 49 | 6,082 | 6,131 | 400 | 5,731 | 108·2 | .. |
| April | 2,945 | 5,731 | 8,676 | 400 | 8,276 | 122 | .. |
| May | 482 | 8,276 | 8,758 | 400 | 8,358 | 123 | .. |

* Power gives 400 to Irrigation.

| Month. | Total discharge of Periyár. | Balance in reservoir on the first of the month. | Total supply available. | Demand. | Balance in reservoir at the end of the month. | Lake level corre-sponding. | Surplus or deficiency. |
|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| *1899–1900.* | | | | | | | |
| June .. .. .. .. | 4,300 | 8,358 | 12,658 | 2,500 | 10,158 | 131 | .. |
| July .. .. .. .. | 8,207 | 10,158 | 18,365 | 2,500 | 15,662 | 152 | + 203 |
| August .. .. .. .. | 1,128 | 15,662 | 16,790 | 3,000 | 13,790 | 145 | .. |
| September .. .. .. .. | 742 | 13,790 | 14,532 | 3,160 | 11,372 | 137 | .. |
| October .. .. .. .. | 3,518 | 11,372 | 14,890 | 3,160 | 11,730 | 138 | .. |
| November .. .. .. .. | 1,471 | 11,730 | 13,201 | 3,160 | 10,041 | 131 | .. |
| December .. .. .. .. | 1,467 | 10,041 | 11,508 | 3,160 | 8,348 | 123 | .. |
| January .. .. .. .. | 212 | 8,348 | 8,560 | 2,220 | 6,324 | 112 | — 940 |
| February .. .. .. .. | 50 | 6,324 | 6,374 | 400 | 5,974 | 109·8 | —1,450 |
| March .. .. .. .. | 20 | 5,974 | 5,994 | 400 | 5,594 | 107·0 | .. |
| April .. .. .. .. | 187 | 5,594 | 5,781 | 400 | 5,381 | 106 | .. |
| May .. .. .. .. | 346 | 5,381 | 5,727 | 400 | 5,327 | 105·5 | .. |
| *1900–1901.* | | | | | | | |
| June .. .. .. .. | 3,159 | 5,327 | 8,486 | 2,162* | 6,324 | 112 | — 338 |
| July .. .. .. .. | 9,325 | 6,324 | 15,649 | 2,500 | 13,149 | 143 | .. |
| August .. .. .. .. | 13,002 | 13,149 | 26,151 | 3,000 | 15,662 | 152 | + 7,489 |
| September .. .. .. .. | 2,448 | 15,662 | 18,110 | 3,160 | 14,950 | 150 | .. |
| October .. .. .. .. | 2,589 | 14,950 | 17,539 | 3,160 | 14,379 | 148 | .. |
| November .. .. .. .. | 3,922 | 14,379 | 18,301 | 3,160 | 15,141 | 150 | .. |
| December .. .. .. .. | 1,702 | 15,141 | 16,843 | 3,160 | 13,683 | 145 | .. |
| January .. .. .. .. | 1,220 | 13,683 | 14,903 | 3,160 | 11,743 | 138 | .. |
| February .. .. .. .. | 493 | 11,743 | 12,236 | 1,850 | 10,386 | 133 | .. |
| March .. .. .. .. | 1,232 | 10,386 | 11,618 | 400 | 11,218 | 136 | .. |
| April .. .. .. .. | 540 | 11,218 | 11,758 | 400 | 11,358 | 137 | .. |
| May .. .. .. .. | 188 | 11,358 | 11,546 | 400 | 11,146 | 136 | .. |
| *1901–1902.* | | | | | | | |
| June .. .. .. .. | 4,080 | 11,146 | 15,226 | 2,500 | 12,726 | 142 | .. |
| July .. .. .. .. | 7,666 | 12,726 | 20,392 | 2,500 | 15,662 | 152 | + 2,230 |
| August .. .. .. .. | 3,257 | 15,662 | 18,919 | 3,000 | 15,662 | 152 | + 257 |
| September .. .. .. .. | 1,219 | 15,662 | 16,881 | 3,160 | 13,721 | 146 | .. |
| October .. .. .. .. | 2,591 | 13,721 | 16,312 | 3,160 | 13,152 | 143 | .. |
| November .. .. .. .. | 6,036 | 13,152 | 19,188 | 3,160 | 15,662 | 152 | + 366 |
| December .. .. .. .. | 1,450 | 15,662 | 17,112 | 3,160 | 13,952 | 146 | .. |
| January .. .. .. .. | 2,467 | 13,952 | 16,419 | 3,160 | 13,259 | 144 | .. |
| February .. .. .. .. | 264 | 13,259 | 13,523 | 1,850 | 11,673 | 138 | .. |
| March .. .. .. .. | 22 | 11,673 | 11,695 | 400 | 11,295 | 136 | .. |
| April .. .. .. .. | 151 | 11,295 | 11,446 | 400 | 11,046 | 135 | .. |
| May .. .. .. .. | 75 | 11,046 | 11,121 | 400 | 10,721 | 134 | .. |
| *1902–1903.* | | | | | | | |
| June .. .. .. .. | 58 | 10,721 | 10,779 | 2,500 | 8,279 | 123 | .. |
| July .. .. .. .. | 5,814 | 8,279 | 14,093 | 2,500 | 11,593 | 137 | .. |
| August .. .. .. .. | 1,591 | 11,593 | 13,184 | 3,000 | 10,184 | 131 | .. |
| September .. .. .. .. | 3,324 | 10,184 | 13,508 | 3,160 | 10,348 | 132 | .. |
| October .. .. .. .. | 8,323 | 10,348 | 18,671 | 3,160 | 15,511 | 152 | .. |
| November .. .. .. .. | 7,461 | 15,511 | 22,972 | 3,160 | 15,662 | 152 | .. |
| December .. .. .. .. | 6,872 | 15,662 | 22,534 | 3,160 | 15,662 | 152 | + 4,150 |
| January .. .. .. .. | 551 | 15,662 | 16,213 | 3,160 | 13,053 | 152 | + 3,712 |
| February .. .. .. .. | 153 | 13,053 | 13,206 | 1,850 | 11,356 | 143 | .. |
| March .. .. .. .. | .. | 11,356 | 11,356 | 400 | 10,956 | 138 | .. |
| April .. .. .. .. | 23 | 10,956 | 10,979 | 400 | 10,579 | 135 | .. |
| May .. .. .. .. | 280 | 10,579 | 10,859 | 400 | 10,459 | 133 | .. |
| *1903–1904.* | | | | | | | |
| June .. .. .. .. | 682 | 10,459 | 11,141 | 2,500 | 8,641 | 125 | .. |
| July .. .. .. .. | 9,167 | 8,641 | 17,808 | 2,500 | 15,308 | 151 | .. |
| August .. .. .. .. | 4,909 | 15,308 | 20,217 | 3,000 | 15,662 | 152 | + 1,555 |
| September .. .. .. .. | 3,411 | 15,662 | 19,073 | 3,160 | 15,662 | 152 | + 251 |
| October .. .. .. .. | 4,528 | 15,662 | 20,190 | 3,160 | 15,662 | 152 | + 1,368 |
| November .. .. .. .. | 1,722 | 15,662 | 17,384 | 3,160 | 14,224 | 147 | .. |
| December .. .. .. .. | 5,939 | 14,224 | 20,163 | 3,160 | 15,662 | 152 | + 1,341 |
| January .. .. .. .. | 959 | 15,662 | 16,621 | 3,160 | 13,461 | 145 | .. |
| February .. .. .. .. | 183 | 13,461 | 13,644 | 1,850 | 11,794 | 138 | .. |
| March .. .. .. .. | 9 | 11,794 | 11,803 | 400 | 11,403 | 137 | .. |
| April .. .. .. .. | 93 | 11,403 | 11,496 | 400 | 11,096 | 135 | .. |
| May .. .. .. .. | 134 | 11,096 | 11,230 | 400 | 10,830 | 134 | .. |

* This could not have been used. Water reaches 112 about the 24th only. About $400 \times \frac{24}{30} + 600 = 920$ millions could have been used.

| Month.<br>1 | Total discharge of Periyár.<br>2 | Balance in reservoir on the first of the month.<br>3 | Total supply available.<br>4 | Demand.<br>5 | Balance in reservoir at the end of the month.<br>6 | Lake level corre-sponding.<br>7 | Surplus or deficiency.<br>8 |
|---|---|---|---|---|---|---|---|
| | | | *1904–1905.* | | | | |
| June .. .. .. .. | 10,110 | 10,830 | 20,940 | 2,500 | 15,662 | 152 | + 2,778 |
| July .. .. .. .. | 9,330 | 15,662 | 24,992 | 2,500 | 15,662 | 152 | + 6,830 |
| August .. .. .. .. | 4,341 | 15,662 | 20,003 | 3,000 | 15,662 | 152 | + 1,341 |
| September .. .. .. .. | 1,400 | 15,662 | 17,062 | 3,160 | 13,902 | 146 | .. |
| October .. .. .. .. | 4,291 | 13,902 | 18,193 | 3,160 | 15,033 | 150 | .. |
| November .. .. .. .. | 1,108 | 15,033 | 16,141 | 3,160 | 12,981 | 143 | .. |
| December .. .. .. .. | 460 | 12,981 | 13,441 | 3,160 | 10,281 | 132 | .. |
| January .. .. .. .. | 200 | 10,281 | 10,481 | 3,160 | 7,321 | 118 | .. |
| February .. .. .. .. | 502 | 7,321 | 7,823 | 1,499 | 6,324 | 112 | .. |
| March .. .. .. .. | 17 | 6,324 | 6,341 | 400 | 5,941 | 109·6 | — 354 |
| April .. .. .. .. | 554 | 5,941 | 6,495 | 400 | 6,095 | 110·6 | .. |
| May .. .. .. .. | 448 | 6,095 | 6,543 | 400 | 6,143 | 111 | .. |
| | | | *1905–1906.* | | | | |
| June .. .. .. .. | 3,484 | 6,143 | 9,627 | 2,500 | 7,127 | 117 | .. |
| July .. .. .. .. | 3,672 | 7,127 | 10,799 | 2,500 | 8,299 | 121 | .. |
| August .. .. .. .. | 1,138 | 8,299 | 9,437 | 3,000 | 6,437 | 113 | .. |
| September .. .. .. .. | 2,053 | 6,437 | 8,490 | 2,166 | 6,324 | 112 | — 994 |
| October .. .. .. .. | 4,575 | 6,324 | 10,899 | 3,160 | 6,739 | 114·5 | .. |
| November .. .. .. .. | 2,566 | 6,739 | 9,305 | 1,981 | 6,324 | 112 | — 1,179 |
| December .. .. .. .. | 700 | 6,324 | 7,024 | 700 | 6,324 | 112 | — 2,460 |
| January .. .. .. .. | 221 | 6,324 | 6,545 | 400 | 6,145 | 111 | — 2,760 |
| February .. .. .. .. | 40 | 6,145 | 6,185 | 400 | 5,785 | 108·5 | — 1,450 |
| March .. .. .. .. | 88 | 5,785 | 5,873 | 400 | 5,473 | 106·6 | .. |
| April .. .. .. .. | 45 | 5,473 | 5,518 | 400 | 5,118 | 104·3 | .. |
| May .. .. .. .. | 222 | 5,118 | 5,340 | 400 | 4,940 | 102·9 | .. |
| | | | *1906–1907.* | | | | |
| June .. .. .. .. | 958 | 4,940 | 5,898 | 400 | 5,498 | 106·8 | — 2,100 |
| July .. .. .. .. | 4,309 | 5,498 | 9,807 | 2,500 | 7,307 | 118 | .. |
| August .. .. .. .. | 6,656 | 7,307 | 13,963 | 3,000 | 10,963 | 135 | .. |
| September .. .. .. .. | 1,371 | 10,963 | 12,334 | 3,160 | 9,174 | 127 | .. |
| October .. .. .. .. | 2,942 | 9,174 | 12,116 | 3,160 | 8,956 | 126 | .. |
| November .. .. .. .. | 3,966 | 8,956 | 12,922 | 3,160 | 9,762 | 130 | .. |
| December .. .. .. .. | 1,804 | 9,762 | 11,566 | 3,160 | 8,406 | 123 | .. |
| January .. .. .. .. | 771 | 8,406 | 9,177 | 2,853 | 6,324 | 112 | — 307 |
| February .. .. .. .. | 73 | 6,324 | 6,397 | 400 | 5,997 | 110 | — 1,450 |
| March .. .. .. .. | 202 | 5,997 | 6,199 | 400 | 5,799 | 108·7 | .. |
| April .. .. .. .. | 595 | 5,799 | 6,394 | 400 | 5,994 | 110 | .. |
| May .. .. .. .. | 70 | 5,994 | 6,064 | 400 | 5,664 | 108 | .. |
| | | | *1907–1908.* | | | | |
| June .. .. .. .. | 2,111 | 5,664 | 7,775 | 1,451 | 6,324 | 112 | — 1,049 |
| July .. .. .. .. | 5,342 | 6,324 | 11,666 | 2,500 | 9,166 | 127 | .. |
| August .. .. .. .. | 11,543 | 9,166 | 20,609 | 3,000 | 15,662 | 152 | + 1,947 |
| September .. .. .. .. | 1,640 | 15,662 | 17,302 | 3,160 | 14,142 | 147 | .. |
| October .. .. .. .. | 5,661 | 14,142 | 19,803 | 3,160 | 15,662 | 152 | + 981 |
| November .. .. .. .. | 9,321 | 15,662 | 24,983 | 3,160 | 15,662 | 152 | + 6,161 |
| December .. .. .. .. | 1,795 | 15,662 | 17,457 | 3,160 | 14,297 | 147 | .. |
| January .. .. .. .. | 1,417 | 14,297 | 15,714 | 3,160 | 12,554 | 141 | .. |
| February .. .. .. .. | 376 | 12,554 | 12,930 | 1,850 | 11,080 | 135 | .. |
| March .. .. .. .. | 174 | 11,080 | 11,254 | 400 | 10,854 | 134 | .. |

# Government of Madras.

## PUBLIC WORKS DEPARTMENT.

IRRIGATION.
ACCOUNT.

| | | |
|---|---|---|
| *Recd.* | 1909. | *Enclosures* |
| *Regd.* | | *Spare copies* |

## G.O., Nos. 276, $\frac{276}{A}$ I., 29th June 1909.

**Vetapalem branch channel, Kistna Western Division**

Forwarding, for information, a copy of the proceedings sanctioning an estimate, amounting to Rs. 22,169, for the excavation of —.

GOVERNMENT OF MADRAS.

PUBLIC WORKS DEPARTMENT.

**Irrigation.**
**Account.**

READ—the following papers :—

I

*Letter*—from J. H. MEDLICOTT, Esq., Superintending Engineer, II Circle.
*To*—the Chief Engineer for Irrigation.
*Dated*—Bezwada, the 20th April 1906.
*No.*—31 I.

I have the honour to forward herewith for your approval and favour of sanction of Government under "49. Open Capital Account" plans and estimates amounting to Rs. 16,700 for excavating Vetapalem branch from 4 miles of Jagarlamudi channel of Commamur canal, Kistna Western Division.

2. The work is remunerative.

3. The report which accompanies the estimate explains the necessity for the work.

II

**Memorandum No. 1512, dated 2nd May 1906.**

With reference to letter No. 31-I., dated 20th April 1906, from the Superintending Engineer, II Circle, submitting an estimate for excavating Vetapalem branch from the 4th mile of Jagarlamudi channel, the Chief Engineer for Irrigation has the honour to observe that the opinion of the Collector does not appear to have been obtained on the scheme. The Superintending Engineer is requested to be so good as to obtain and submit the Collector's opinion on the scheme. In the meantime the estimate will be checked.

(By Order.)

T. W. S SMYTH,
*Asst. Chief Engineer for Irrigation.*

To the Super ntending Engineer, II Circle.

III

**Memorandum No. 3697, dated 6th October 1906.**

With reference to his letter No. 31-I., dated 20th April 1906, and in continuation of this office No. 1512, dated 2nd May 1906, the Superintending Engineer, II Circle, is requested to reconsider the proposals in the light of the observations of the Chief Engineer for Irrigation.

The proposed supply channel 5 miles and a quarter long runs parallel to Jagarlamudi channel at about a quarter of a mile away from it. Unless the Jagarlamudi channel itself has been taken on a very bad alignment, the necessity for the proposed channel is not quite clear. Presumably the Jagarlamudi channel runs on the ridge between the two drains Tungabhadra drain and the Konderu affluent and should be capable of irrigating all the lands proposed to be benefited under the estimate now submitted. It appears as if it would be much cheaper as much land compensation would be saved and just as effective to remove the drop at the 4th mile of Jagarlamudi channel and rebuild it at the 8th and raise the banks by about 4 feet and to provide a bed regulator if necessary at the 6th mile. The Superintending Engineer is requested to be good enough to report upon the above suggestions and adopt them if feasible and cheaper.

(By Order.)

T. W. S. SMYTH,
*Asst. Chief Engineer for Irrigation.*

To the Superintending Engineer, II Circle.

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## IV

*Letter*—from Lieut.-Col. W. M. ELLIS, R.E., Superintending Engineer, II Circle.
*To*—the Chief Engineer for Irrigation.
*Dated*—Bezwada, the 27th November 1907.
*No.*—438 I.

[Your No. 3697 of 6th October 1906.]

I have the honour to resubmit a fresh estimate for excavating Vetapalem branch channel.

The block levels and contours on the plan show that between Jagarlamudi channel and the Tungabhadra drain there is a subsidiary ridge along which the proposed new channel has been aligned.

2. An estimate was prepared for irrigating the proposed new irrigation by distributaries taking off from the left of Jagarlamudi channel.

This estimate came to more than that now submitted besides intercepting the natural drainage along the Mamillapalli Polimera and is therefore not submitted.

Further necessary information is given in the plans and estimates now submitted and to which sanction is asked.

---

## V

### Memorandum No. 13, dated 3rd January 1908.

With reference to letter No. 438 I., dated 27th November 1907, from the Superintending Engineer, II Circle, the Acting Chief Engineer for Irrigation has the honour to return with the following remarks the plans and estimates amounting to Rupees 16,070 for excavating Vetapalem branch channel therewith submitted :—

(*a*) The sections of the proposed branch channel as designed give mean velocities ranging from 0·80 to 0·50 feet per second which are considered low. It seems advisable to increase the bed fall from 6 inches to 1 foot per mile from 1 mile 4 furlongs to 4 miles and give a uniform depth of 2′ 3″ for the first 4 miles. This arrangement would save the drop at 2 miles 4 furlongs, reduce silting and give a good command. If the Superintending Engineer sees no objection to the above proposal the estimate may be revised accordingly.

(*b*) The hydraulic particulars of the Jagarlamudi channel from the head down to the proposed offtake should be furnished to ascertain if the channel can carry supply for the increased area under it.

(c) In resubmitting the estimate the Superintending Engineer should state whether the Collector has approved the scheme under reference. If not, the Collector's opinion should be obtained and furnished as requested in this office memorandum No. 1512, dated 2nd May 1906.

H. E. Clerk,
*Ag. Chief Engineer for Irrigation.*

To the Superintending Engineer, II Circle.

## VI

Petition from the ryots of Aremanda, dated 25th August 1908.
To the ryots of Aremanda, dated 12th September 1908, No. 3386.

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## VII

*Letter*—from S. B. Murray, Esq., A.M.I.C.E., Superintending Engineer, II Circle.
*To*—the Chief Engineer for Irrigation.
*Dated*—Bezwada, the 16th April 1909.
*No.*—18 I.

With reference to your No. 13, dated 3rd January 1908, I have the honour to forward herewith, for the sanction of Government, plans and estimates amounting to Rs. 19,900 for excavating Vetapalem branch channel, at 4th mile of Jagarlamudi channel, Commamur canal, revised as ordered by you.

2. A tabular statement showing the hydraulic particulars of the Jagarlamudi channel from the head down to the proposed offtake accompanies the estimates.

3. The Collector has approved of the proposed scheme, see copy of his No. 1422/Gl. of 1906, dated 2nd November 1906, to the Executive Engineer, Kistna Western Division, enclosed.

4. Permission was given to the Executive Engineer by my predecessor for the collection of materials in anticipation of sanction to the estimates.

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Enclosures.

*Report to accompany the estimate for the proposed Vetapalem branch at 4th mile of Jagarlamudi channel, Commamur canal.*

| | RS. |
|---|---|
| Amount of estimate ... ... ... ... ... ... ... | 19,900 |

Jagarlamudi channel was designed originally to command an area of about 3,200 acres below the 4th mile, of which only 2,241 acres are irrigated at present; the remaining being mostly high level lands, could not be commanded from the existing channels. A portion of the area already irrigated, viz. (2,241 acres) is getting water with great difficulty at present.

2. There are two ways of irrigating this block properly, viz. (1) by excavating a new branch on the ridge line, more or less parallel to the existing channel, from the 4th mile, or (2) by improving Jagarlamudi channel below the 4th mile and excavating minor branches at suitable intervals from it.

3. The present estimate provides for the former proposal which is the cheaper of the two and is effective. The channel will run on an alignment which will not cross any lines of drainage.

4. The new branch will take off from above the drop at 4th mile 1 furlong and will be on the ridge line throughout, so as to command easily all the high level lands, about 1,900 acres, which at present cannot be irrigated from the existing channel, or partly irrigated with great difficulty. The channel will be 11 feet wide at the head with side slopes of 1 to 1, a bed fall of 6″ and 12″ and an O.S.L. of 2·25′ as noted in the tabular statement accompanying the estimate.

5. A new head sluice, a grade wall and a Trapezoidal Notch will be constructed at 0/0, ¼ and 4/0, respectively. Where the channel crosses donkas, cattle crossings will be provided, and a bridge will be constructed at 5 miles 6 furlongs 330 feet where the proposed channel crosses an important donka.

6. A lump sum of Rs. 1,000 is provided in the estimate for spouting the channel during execution, but a supplemental estimate, with correct spout lists, will be prepared.

Compensation for land has been fixed by the Revenue Department.

7. It will be seen from the financial statement that the project is a remunerative one, giving a return of 1·9 per cent. on the proposed outlay, and it is therefore recommended for early sanction.

8. The Collector has also approved the proposed scheme and recommends its construction.

9. Provision will be made for restricting the ventway of the drop at 4 miles 1 furlong of Jagarlamudi channel to irrigate only 1,300 acres in the estimate for remodelling Jagarlamudi channel now under preparation.

A. V. RAMALINGA AIYAR,
*Executive Engineer, Kistna Western Division.*

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*Note on irrigation under Commamur canal.*

| | | ACRES. |
|---|---|---|
| Area allotted for this canal under G.O., No. 738 I., dated 6th July 1906, is | ... | 130,000 |
| Area allotted for 1st reach off the canal ... | ... | 55,000 |
| Area irrigated during last fasli under distributaries, 1st reach | ... | 31,374 |
| | or say ... | 31,400 |
| Area proposed to be brought under Appapuram project | ... | 20,000 |
| Area proposed to be brought under cultivation by improvements to Tungabhadra side channel, which takes off fram 1st reach, Commamur canal | ... | 2,600 |
| Area proposed under proposed Vetapalem branch from Jagarlamudi channel | ... | 962 |
| | or say ... | 1,000 |
| | | 55,000 |

Maximum discharge required for 130,000 at 70 duty during transplantation season, 1,857 cusecs.

Bottom width of 1st reach, Commamur canal, 130 feet.

Side slopes, 2 to 1.

Bed fall, 0·46 feet per mile.

M.S.L., 6·25 feet.

Let N = ·02 in Kutter's formula.

Discharge = 2,022 cusecs.

*Vide* also Appendix II of G.O., No. 738 I., dated 6th July 1906, Appapuram project.

There is therefore water available for cultivation (1,000 acres) under the proposed Vetapalem channel of Jagarlamudi channel and for 2,600 acres under Tungabhadra Side channel in addition to the area to be brought under cultivation under Appapuram project.

A. V. RAMALINGA AIYAR,
*Executive Engineer, Kistna Western Division.*

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*Letter*—from the Collector of Guntúr.
*To*—the Executive Engineer, Kistna Western Division.
*Dated*—the 2nd November 1906.
*No.*—1422-Gl.

In returning herewith the plan showing the proposed Vetapalem branch channel and the report accompanying the estimate received with your No. 214 M., dated 7th May 1906, I have the honour to state that it appears to be likely that the channel would bring irrigation not only to the 440 acres in the villages of Vetapalem and Modukur of Tenali taluk, which you have allowed for, but also to 460 acres in Aremanda village of Bápatla taluk as well and that the ryots of all three villages are said to be most anxious for the project to be carried out so that their dry lands may be converted into wet. There appears therefore to be every prospect of the project proving remunerative and I would recommend that it should be carried out.

Estimate Form—*Abstract*—Classified.

| Sub-head. | Names of works. | Amount of estimate for individual works. | Total of sub-heads. | Total for each canal or distributary. | Total of each main head. | Remarks. |
|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| | CAPITAL EXPENDITURE NOT CHARGED TO REVENUE.<br>49. Irrigation.<br>*Kistna Delta system.*<br>Open Capital account.<br>Western section.<br>I. Works.<br>Commamur canal.<br>3. Distributaries.<br>Excavating Vetapalem channel at 4 miles of Jagarlamudi channel of Commamur canal. | RS. | RS. | | | |
| B. Land .. | 1. Compensation of land .. .. | 11,370 | 11,370 | | | |
| C. Works .. | 2. Head sluice .. .. .. | 530 | | | | |
| | 3. Grade wall at ½ .. .. .. | 11 | | | | |
| | 4. Trapezoidal notch at 4/0 .. .. | 340 | | | | |
| | 5. Bridge at 5 miles 6 furlongs 330 feet .. | 470 | | | | |
| | 6. Tail drop at 6 miles 1 furlong .. | 270 | | | | |
| | Spouting to channel L.S. .. .. | 1,000 | 2,621 | | | |
| L. Earthwork .. | 7. Excavating channel .. .. | 3,700 | 3,700 | | | |
| O. Miscellaneous. | 8. Cattle crossing at 0/7 330 feet .. | 255 | | | | |
| | 9. Do. at 2 miles 0 furlong 600 ft. | 250 | | | | |
| | 10. Do. at 3 ,, 0 ,, 330 ,, | 274 | | | | |
| | 11. Do. at 4 ,, 0 ,, 330 ,, | 310 | | | | |
| | 12. Do. at 4 ,, 3 ,, 330 ,, | 310 | | | | |
| | 13. Do. at 5 ,, 0 ,, 330 ,, | 310 | | | | |
| | 14. Do. at 5 ,, 3 ,, 0 ,, | 310 | | | | |
| | 15. Fixing mile, furloug and demarcation stones. | 370 | | | | |
| | 16. Demarcating the sub-division of fields .. | 70 | 2,459 | | | |
| | Total .. | | | 20,150 | | |

A. V. Ramalinga Aiyar,
*Executive Engineer, Kistna Western Division.*

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## VIII

### Note by the Chief Engineer for Irrigation, dated 13th June 1909.

The papers read above relate to the excavation of Vetapalem branch channel from Jagarlamudi channel, Commamur canal, Kistna Western division.

2. The Superintending Engineer, II Circle, submitted an estimate, amounting to Rs. 16,700, for excavating Vetapalem branch channel from above the drop at 4 miles of the Jagarlamudi channel, which takes off at 20 miles 50 chains of the Commamur canal, Kistna Western division. The papers were returned to the Superintending Engineer twice for reconsideration as to the necessity for the work and for revision and resubmission together with the Collector's opinion on the proposal.

3. The Superintending Engineer now resubmits the estimate duly revised amounting to Rs. 19,900. It is stated that the irrigable area under the Jagarlamudi channel below its fourth mile is about 3,200 acres, of which the area irrigated at present amounts to only 2,241 acres and that the remaining extent being mostly high level lands could not be irrigated from the existing channel. It is further stated that a portion of the area already brought under cultivation has not been satisfactorily supplied by the existing channel at present such lands being on a high

level. The excavation of the proposed branch is necessary in order to bring the whole irrigable area under cultivation as also to command a fair and easy supply to all the high level lands. The proposed branch, which is intended to irrigate 1,900 acres, has been aligned newly along a subsidiary ridge line more or less parallel to the existing channel so as to command all the high level lands, and this course is found cheaper than remodelling the existing channel to gain the same effect.

4. The estimate provides for—

| | RS. |
|---|---|
| 1. Excavating channel ... ... ... ... ... ... | 3,700 |
| 2. Constructing a head sluice for excavating channel ... ... | 500 |
| 3. Constructing a trapezoidal notch at 4 miles, a culvert at the road crossing at 5 miles 6½ furlongs and a drop at tail end ... | 1,030 |
| 4. Constructing seven cattle crossings ... ... ... | 1,870 |
| 5. Spouting channel for the distribution of supply ... ... | 1,000 |
| 6. Land compensation for the channel course ... ... ... | 11,370 |
| 7. Demarcation ... ... ... ... ... ... ... | 430 |
| Total .. | 19,900 |

The proposed branch channel is 6½ miles long and is divided into eight reaches with bed falls and velocities varying from 12 inches to 6 inches per mile and 1·10 to 0·51 feet per second respectively. As the velocities in some of the reaches are very low it is suggested that the adoption of a uniform bed fall of 9 inches per mile throughout would be an improvement on the Superintending Engineer's proposal, and this is a matter for his consideration before execution.

5. It is stated that land compensation has been fixed in consultation with the Revenue authorities. The Collector has approved the proposed scheme and recommends its execution.

6. The data sheets, which accompanied the estimates now submitted, were apparently prepared in 1907–1908 and the initial rates of some of the items which were found to be low have been altered to agree with the latest schedule of rates for 1908–1909 of the Kistna Western division. This alteration has increased the total amount of the estimate from Rs. 19,900 to Rs. 20,150.

7. The work is "remunerative" as the revenue anticipated from it has been estimated at Rs. 3,848, which represents a return of 19 per cent. on the estimated outlay. It is recommended that the estimate, as altered, be sanctioned.

8. It is stated that the Executive Engineer was given permission by the Superintending Engineer (Colonel Ellis) to proceed with the collection of materials for the work in anticipation of sanction to the estimate. The action of the latter officer may be approved.

C. A. SMITH,
*Chief Engineer for Irrigation.*

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**Order—No. 276 I., dated 29th June 1909.**

The following estimate is sanctioned :—

Imperial.
Capital expenditure not charged to Revenue.
49. Irrigation.
Open capital account.
Kistna delta system.
Western division.
I. Works.
Commamur canal.
3. Distributaries.
Remunerative work.
Excavating Vetapalem channel at 4 miles of Jagerlamudy channel of Commamur canal.

| | RS. |
|---|---|
| B. Land—Compensation for land ... ... ... ... ... | 11,370 |

| | RS. |
|---|---|
| C. Works—Head sluice ... ... ... ... ... ... | 530 |
| Grade wall at ¼ ... ... ... ... ... ... ... | 11 |
| Trapezoidal notch at 4/0 ... ... ... ... ... ... | 340 |
| Bridge at 5 miles 6 furlongs 330 feet ... ... ... ... ... | 470 |
| Tail drop at 6 miles 1 furlong ... ... ... ... ... | 270 |
| Spouting the channnel L.S. ... ... ... ... ... ... | 1,000 |
| | 2,621 |
| L. Earthwork—Excavating channel ... ... ... ... ... | 3,700 |
| O. Miscellaneous— | |
| Cattle crossing at 0/7–330 ... ... ... ... ... | 255 |
| ,, at 2 miles 0 furlong 600 feet ... ... ... | 250 |
| ,, at 3 ,, 0 ,, 330 ,, ... ... ... | 274 |
| ,, at 4 ,, 0 ,, 330 ,, ... ... ... | 310 |
| ,, at 4 ,, 3 furlongs 330 ,, ... ... ... | 310 |
| ,, at 5 ,, 0 furlong 330 ,, ... ... ... | 310 |
| ,, at 5 ,, 3 furlongs 0 ,, ... ... ... | 310 |
| Fixing mile, furlong and demarcation stones .. ... ... ... | 370 |
| Demarcating the sub-division of fields ... ... ... ... | 70 |
| Total ... | 2,459 |

| | |
|---|---|
| Estimate— | |
| I. Works ... ... ... ... ... ... ... ... | 20,150 |
| II. Establishment ... ... ... ... ... ... ... | 2,019 |
| Total ... | 22,169 |

2. This sanction is registered as No. 47 I. of 1909–1910 and will expire on 31st March 1911.

3. The attention of the Superintending Engineer is drawn to the concluding portion of paragraph 4 of the note by the Chief Engineer for Irrigation.

4. The action of the Superintending Engineer (Colonel Ellis) in having permitted the collection of materials in anticipation of sanction to the work is approved.

5. Ordered that a copy of these proceedings be forwarded to the Government of India for information.

[Here enter No. $\frac{276}{A}$ I., dated 29th June 1909.]

(True Extract.)

C. A. Smith,
*Joint Secy. to Govt., P.W.D.,*
*Irrigation Branch.*

To the Chief Engineer for Irrigation.
,, Superintending Engineer, II Circle, with plans and estimate.
,, Examiner, Public Works Accounts.

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**Endorsement—No. $\frac{276}{A}$ I., dated 29th June 1909.**

Forwarded.

(By Order.)

C. A. Smith,
*Joint Secy. to Govt., P.W.D.,*
*Irrigation Branch.*

# Government of Madras.

## PUBLIC WORKS DEPARTMENT.

IRRIGATION.

*Recd.* } 1909 *Enclosures*

*Regd.* *Spare copies*

## G.O., No. 277 I., 29th June 1909.

### Special Revenue Officer, Kistna Reservoir Project.

Fixing Guntúr as the head-quarters of the —, stating that, for the purpose of drawing bills, he should be treated as an officer of the Public Works Department, and allowing him an imprest of Rs. 135.

GOVERNMENT OF MADRAS.

# PUBLIC WORKS DEPARTMENT.

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## Irrigation.

READ—the following papers :—

I

### Reference from the Board of Revenue (R.S., Sur., L. Rds. and Agri.), No. 1090, dated 11th May 1909.

*Read*—the following paper :—

*Letter*—from J. M. TURING, Esq., I.C.S., Revenue Officer on Special duty, Kistna Reservoir Project.

*To*—the Secretary to the Commissioner of Revenue Settlement, Survey, Land Records and Agriculture.

*Dated*—the 7th May 1909.

*No.*—7/G1.

G.O., No. 276, Public, dated 24th April 1909, appointing me as the Special Revenue Officer for the investigation of the Kistna Reservoir Project does not specify my head-quarters. Indeed I wrote demi-officially before my appointment to the Under Secretary to Government in the Revenue Department, suggesting that the point might be left for subsequent settlement, since part of the work was more accessible from Bezwada than Guntúr.

2. I now recommend that Guntúr may be declared to be my head-quarters at once. I find it important that I should be in touch with the Guntúr Collector's office and with the Executive Engineer in charge of the project, and that there is little to choose between the two places as a centre for inspection purposes. I can also get some office accommodation at Guntúr, but not at Bezwada.

3. I request that very early orders may be passed on the point, as it affects the date from which my special duty should begin, and the Accountant-General has wired for information on the last point. If my head-quarters is Guntúr, I am entitled to the usual joining time. If it is Bezwada, I am not, as there is no change of station. As a matter of fact, I have worked since my relief on the preliminary arrangements connected with my special duty, but as the period of the duty is very short, I should prefer to put the date of its commencement as late as the 4th May, from which date I have entertained a small part of the establishment sanctioned.

4. I also request to be favoured with the Board's orders as to whether in the matter of drawing bills, permanent advance, obtaining supplies of office requisites and the like, I am to be treated as an officer working under the Public Works Department or the Revenue Department. I understand that the practice as regards these matters is not uniform in the case of officers making a revenue investigation of Public Works Department projects, and the Superintending Engineer in charge of the project can give me no information on the subject.

5. Probably the most convenient plan will be for me to be treated as an officer of the Revenue Department, my expenditure being subsequently adjusted to the cost of the project.

6. I request accordingly that the Board may be pleased to sanction to me a permanent advance of Rs. 200 which will be required for myself and the three Tahsildars under me. I request also that the Superintendent of Stationery may be instructed to comply with my indents up to the limit allowed by rule for the establishment to be entertained, and that the Director of Survey may be asked to comply with my requisitions for maps and plans in so far as he can do so. Further, I request that I may be permitted to incur expenditure up to a limit of Rs. 200 on office furniture and the like. I will endeavour to reduce expenditure to a minimum under this head by borrowing from the permanent offices.

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*Reference—No.* 1090, *dated* 11*th May* 1909.

Submitted for the orders of Government.

2. The Board supports the Special Revenue Officer's request that Guntúr may be declared to be his head-quarters.

3. The Board agrees with Mr. Turing that the Special Revenue Officer should be treated during his special duty as an officer of the Revenue Department. He may be granted the same permanent advance as was granted to Mr. Braidwood in G.O., No. 119, Financial, dated 10th February 1904, when employed on similar duty, viz., Rs. 135, distributed as shown in the margin.

| | RS. |
|---|---|
| Special Revenue Officer ... ... | 45 |
| Three Tahsildars at Rs. 30 each ... | 90 |
| | 135 |

4. The Superintendent of Stationery and the Director of Survey will be requested to comply with Mr. Turing's indents for articles of stationery and maps.

5. As regards furniture, Mr. Turing can utilise the articles handed over to the Collector of Kistna by Mr. Braidwood with reference to Board's Proceedings, No. 4565, dated 22nd August 1904.

L. D. SWAMIKANNU,
*Secretary.*

To the Secretary to Government, Revenue Department (through the Accountant-General).
,, the Superintendent of Stationery, para. 4.
,, the Director of Survey, para. 4.
,, Collectors of Kistna and Guntúr.
,, the Chief Engineer for Irrigation.
,, the Revenue Officer, Kistna Reservoir Project, with a copy of Board's Proceedings, No. 4565, dated 22nd August 1904.

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## II

## Endorsement by the Accountant-General, No. G.A. 42-G/2308, dated 21st May 1909.

Forwarded to the Secretary to the Government of Madras, Revenue Department.

2. There is no audit objection to Mr. Turing being treated during his special duty as an officer of the Revenue Department and allowed a permanent advance of Rs. 135 as recommended by the Board.

3. If it be decided to treat Mr. Turing as a Revenue Officer, the Board of Revenue may be requested to submit a reappropriation statement to meet the extra cost involved in the project on which Mr. Turing is employed.

J. F. GRAHAM,
*Offg. Accountant-General.*

## III

## Reference from the Board of Revenue (R.S., Sur., L.Rds. and Agri.), No. 1296, dated 9th June 1909.

*Read*—the following paper :—

*Letter*—from J. M. TURING, Esq., I.C.S., Special Revenue Officer, Kistna Reservoir Project.
*To*—the Secretary to the Commissioner of Revenue Settlement, Survey, Land Records and Agriculture.
*Dated*—the 4th June 1909.
*No.*—70.

Adverting to Board's Reference, No. 1090, dated 11th May 1909, I have the honour to request that very early orders of Government may be obtained for the grant of permanent advance to me, as much inconvenience is felt by me for want of the same.

2. All expenditure has to be met at present from my private funds or those of my Tahsildars and nearly a month has now elapsed since my special duty began.

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*Reference—No.* 1296, *dated* 9*th June* 1909.

Submitted to Government in continuation of Board's Reference, No. 1090, dated 11th May 1909.

L. D. SWAMIKANNU,
*Secretary.*

To the Secretary to Government, Revenue Department.

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## Order—No. 277 I., dated 29th June 1909.

The proposal of the Board of Revenue to fix Guntúr as the head-quarters of the Special Revenue Officer, Kistna Reservoir Project, is approved.

2. The Government consider that for the purpose of drawing bills, etc., the special officer should be treated as an officer of the Public Works Department. He will be placed in funds against the drawing account of the Executive Engineer, Guntúr division, under paragraph 1460 (2) of the Public Works Code and will be allowed an imprest of Rs. 135 as shown below :—

| | RS. |
|---|---|
| Special Revenue Officer ... ... ... ... ... ... ... | 45 |
| Three Tahsildars at Rs. 30 each ... ... ... ... ... .. | 90 |
| | 135 |

(True Extract.)

C. A. SMITH,
*Joint Secretary to Government, P.W.D.,*
*Irrigation Branch.*

To the Chief Engineer for Irrigation.
,, Superintending Engineer on Special duty.
,, Superintending Engineer, II Circle.
,, Examiner, Public Works Accounts.
,, Special Revenue Officer, Kistna Project.
,, Board of Revenue (Revenue Settlement).
,, Revenue Department.

# Government of Madras.

## PUBLIC WORKS DEPARTMENT.

IRRIGATION.
ACCOUNT.

| | | |
|---|---|---|
| *Recd.* | 1909. | *Enclosures* |
| *Regd.* | | *Spare copies* |

**G.O., No. $\frac{277}{A}$ I., 29th June 1909.**

**Iron punts for the Godavari Northern Division**

An estimate, amounting to Rs. 58,500, for constructing ten —, sanctioned.

No. $\frac{277}{A}$ I., 29TH JUNE 1909.

GOVERNMENT OF MADRAS.

PUBLIC WORKS DEPARTMENT.

**Irrigation.**
**Account.**

**READ**—the following papers :—

I

*Letter*—from C. W. WOOD, Esq., Superintending Engineer, I Circle.
*To*—the Chief Engineer for Irrigation.
*Dated*—Vizagapatam, the 7th June 1909.
*No.*—217-I./G.N.

I have the honour to forward herewith for favour of your approval and sanction an estimate amounting to Rs. 58,500 for building ten iron punts for the use of Gódávari Northern Division.

The report accompanying the estimate explains the necessity for the punts.

ENCLOSURE.

*Report to accompany the estimate for building ten iron punts.*

| | RS. |
|---|---|
| Amount of estimate ... ... ... ... ... ... ... | 58,500 |

[*Reference*—Superintending Engineer's No. 3087-G.N., dated 28th December 1908.]

The formation of the Gódávari Conservancy Division has created a demand for punts which was evidently not anticipated. The total number of the floating plant including punts, barges, light boats, etc., is 67 of which there are 45 punts (that is, fully decked boats) of three distinct types, viz., wooden flats, iron flats and canal iron punts.

These punts are distributed to the various divisions for the supply of materials.

The Conservancy division requires the above type of punts for work in the river for fitting up pile drivers, conveyance of sand and brushwood and for conveyance of stone for groynes, etc., and the large demand made by that division has made it difficult for the other divisions to obtain their materials in good time. At the present time more than half the total number of punts available are working in the Conservancy division and more are required. It is therefore considered absolutely necessary to construct for the present ten iron punts and two barges. The estimate for the barges will be separately submitted. The design of these punts is approximately the same as that of the latest design.

*23rd May* 1909.

C. L. BUSHELL,
*Executive Engineer, Gódávari Northern Division.*

The estimate is recommended for early sanction, as much inconvenience and delay in carrying out works is caused by the insufficiency of the present floating plant.

*June* 1909.

C. W. WOOD,
*Superintending Engineer, I Circle.*

II

**Note by the Chief Engineer for Irrigation, dated 29th June 1909.**

The estimate received with the above letter is recommended for sanction.

C. A. SMITH,
*Chief Engineer for Irrigation.*

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**Order—No. $\frac{277}{A}$ I., dated 29th June 1909.**

The following estimate is sanctioned :—

Divided head.
42. Major Works (Working Expenses).
Gódávari Delta System.
Northern Division.
5. Tools and plant.
4. Navigation plant.
Constructing ten iron punts.

| | RS. |
|---|---|
| Estimate ... ... ... ... ... ... ... ... | 58,500 |

2. This sanction is registered as No. 49 I. of 1909–1910.

3. The following telegram will be sent to the Superintending Engineer :—

Your No. 217 I./G.N., 7th June. Estimate for punts sanctioned.

(True Extract.)

C. A. SMITH,
*Joint Secretary to Govt., P.W.D.,*
*Irrigation Branch.*

To the Chief Engineer for Irrigation.
,, Superintending Engineer, I Circle.
,, Examiner, Public Works Accounts.

# Government of Madras.

## PUBLIC WORKS DEPARTMENT.

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IRRIGATION.

| | | |
|---|---|---|
| *Recd.* | 1909. | *Enclosures* |
| *Regd.* | | *Spare copies* |

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## G.O., No. 278 I., 30th June 1909.

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### Bridges over the Ellore and Ryves' canals at Bezwada

Directing, with remarks, the Superintending Engineer, II Circle, to arrange a conference at which the Collector of Kistna, the Chairman of the Bezwada Municipal Council and the Agent of the Madras and Southern Mahratta Railway Company shall be represented to consider the question of the adequacy of the proposals of the Railway Company in regard to the construction of new —.

GOVERNMENT OF MADRAS.

PUBLIC WORKS DEPARTMENT.

## Irrigation.

READ—again the following papers:—

I

### G.O., No. 251 I., dated 27th May 1889.

ABSTRACT.—Sanctioning an estimate, amounting to Rs. 10,500, for constructing a bridge on the Ellore canal at Bezwada.

### G.O., No. 700 I., dated 1st December 1890.

ABSTRACT.—Sanctioning, with remarks, estimates aggregating Rs. 37,700 for alterations of head of the Ryves' canal.

### G.O., No. 2994 Ry., dated 13th December 1892.

ABSTRACT.—Forwarding to the Government of India copy of proceedings passing orders regarding the construction of an overbridge at Bezwada station on the East Coast Railway.

### G.O., Nos. 1261-62 Ry., dated 22nd July 1902.

ABSTRACT.—Passing orders on the construction of an overbridge across the Bezwada station yard.

II

*Letter*—from Colonel C. C. RAWSON, R.E., Superintending Engineer, II Circle.
*To*—the Chief Engineer for Irrigation (through the Collector of Kistna).
*Dated*—Bezwada, the 13th January 1902.
*No.*—392 I.

I have the honour to draw your attention to page 133 of "Engineering Works of the Kistna Delta" by Mr. Walch, item Ryves' canal, and to G.O., No. 1432 W., dated 26th May 1891. All the works mentioned in this paragraph have been carried out except the raising of the old bridge at the head of Ryves' canal: when there is full supply in the canal, boats cannot pass under this bridge and all the other works carried out are useless.

I would suggest that the question of raising both the bridges over the heads of the Ellore and Ryves' canals be considered in communication with the Railway officials, as it is quite possible that if the District Board and the Railway authorities would join, an overbridge could be built at the level crossing near the canal bridges if they were both raised sufficiently to fit into the approach to the railway bridge and the convenience to the public if these arrangements could be carried out would be very great.

*N.R.C. No.* 1456/*Gl.*, *dated 3rd May* 1902.

Forwarded.

2. It is absolutely necessary that the bridge over the Ryves' canal must be raised if the works carried out below the bridge are to be of any use, and the raising of the bridge over the Ryves' canal almost necessarily involves raising that over the Ellore canal. I do not, however, see any need for raising the two bridges to a greater height than so as to make the level of the roadway the same or nearly the same as that of the level crossing on the railway adjoining the two bridges. There is no need for an overbridge over the railway at present, or until the railway traffic has increased so greatly as to render the present level crossing unusable by carts. Further, the height of such an overbridge would be so much above the level of the ground that the approaches to it must either be very long or very steep, and a steep approach into the old town of Bezwada is very greatly to be deprecated, as the cart traffic is great and it is difficult to control it properly on a steep slope.

As to the cost: if there is to be no overbridge, I do not see how the cost can be charged against the Railway. Nor is the work one in which the District Board has any interest, being within Municipal limits. The cost must fall entirely on the Government or the Bezwada Municipality or on both jointly. But I do not see how the Municipality with its limited income can pay the cost of raising the bridges.

R. MORRIS,
*Collector.*

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III

**Memorandum No. $\frac{II}{121}$ K.S., dated 10th June 1902.**

With reference to letter No. 392 I., dated 13th January 1902, of the Superintending Engineer, II Circle, the undersigned has the honour to request that he will be so good as to submit plans and estimate for raising the two bridges on the Ryves' and Ellore canals. It would appear to be unnecessary to have an overbridge at the level crossing or at least this part of the Superintending Engineer's proposals may be left for future consideration. The bridges may be raised sufficiently to allow of regular boat traffic.

A. W. SMART, COL., R.E.,
*Chief Engineer for Irrigation.*

To the Superintending Engineer, II Circle.

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IV

*Letter*—from H. H. O'CONNELL, Esq., Superintending Engineer, II Circle.
*To*—the Chief Engineer for Irrigation.
*Dated*—Bezwada, the 31st October 1904.
*No.*—326 I.

With reference to your reminder without date on your No. II/121 K.S., dated 10th June 1902, I have the honour to state that plans and estimates for the two bridges over Ellore and Ryves' canals have been received and are being checked in this office.

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V

*Letter*—from H. H. O'CONNELL, Esq., Superintending Engineer, II Circle.
*To*—the Chief Engineer for Irrigation.
*Dated*—Bezwada, the 12th November 1904.
*No.*—349 I.

With reference to your No. II/121 K.S., dated 10th June 1902, I have the honour to forward herewith the plans and estimates for raising the bridge over the head of Ryves' canal and for building a new bridge across the Ellore canal in a straight line with it.

In this connection I beg to call attention to G.O., No. 2994 Ry., dated 12th December 1892, and to G.O., No. 1261 Ry., dated 22nd July 1902. It will be seen from the latter Government Order that for want of an overbridge near the railway station all the traffic is diverted over these two bridges. The level crossing here also is frequently blocked for trains to pass and for trains shunting, but not nearly so frequently as at the level crossing near the railway station. The result is that very often the road on either side of this level crossing is blocked with bandies and when the level crossing gates are opened the traffic is very congested and, owing to the position of the present bridges with reference to one another and to the fact that the roadway of Ryves' bridge is 4 feet lower than that of the Ellore bridge and that there is a stiff incline in the road to the east of Ryves' bridge, there is every likelihood of accidents occurring to the vehicles and pedestrians. This great inconvenience has been in existence for ten years or more and the relief of an over-bridge at the crossing near the railway station seems as far off as ever. As the level crossing is responsible for a good deal of the congestion of traffic that takes place here, I think it would be only fair to ask the railway to bear a portion of the cost of improving matters at this point by making the roadway straight and nearly level. The raising of Ryves' bridge is necessary also in connection with the opening up of Arundelpeta, and from a perusal of page 133 of Mr. Walch's Engineering Works of the Kistna Delta, it would seem that the cost of raising this bridge should be borne by Provincial funds. The District Board and the Municipality of Bezwada will also benefit by the proposed works. I would therefore suggest that the cost of the proposed works be borne by—

(1) Railway department,

(2) Provincial funds,

(3) District Board,

(4) Bezwada Municipality,

in such proportions as Government deems right.

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## VI

### Memorandum No. 96-C., dated 6th January 1905.

The papers read above relate to a proposal to—

(1) raise the bridge over the head of Ryves' canal at Bezwada, and

(2) build a new bridge across the Ellore canal in a straight line with the former.

2. The Superintending Engineer recommends that the cost of the proposed works be borne by the Railway, the Public Works Department, the District Board and the Municipality.

3. The Collector remarks that the District Board have no interest in the work while the Municipality cannot contribute the amount required owing to its limited resources.

4. The Consulting Engineer for Railways does not think that any case can be made out for making the railway pay a share.

5. As the whole cost would thus apparently have to be borne by Provincial funds, the Superintending Engineer is requested to be so good as to reconsider his present proposals. It should be stated whether it would not be possible to substitute a girder for one of the spans of Ryves' bridge, reinforcing the pier to enable it to withstand the thrust of the arch. Perhaps sufficient headway could be obtained in this way without raising the whole bridge.

6. As far as the Chief Engineer can see a new bridge over the Ellore canal would be a convenience but is not a necessity.

W. B. deWinton,
*Chief Engineer, P. W. D.*

To the Superintending Engineer, II Circle, with plans and estimates returned.
Copy to the Chief Engineer for Irrigation.

## VII

*Letter*—from J. H. MEDLICOTT, Esq., Superintending Engineer, II Circle.
*To*—the The Chief Engineer, Public Works Department.
*Dated*—Bezwada, the 10th August 1905.
*No.*—210 W.

With reference to your No. 96-C., dated 6th January 1905, I have the honour to enclose for your perusal some correspondence I have had with the Collector on the subject.

The Collector lays considerable stress on having the road as straight as possible and I quite agree with him. I have marked in green on the enclosed tracing the alignment he recommends.

Ryves bridge ought to be demolished and rebuilt. The piers are at a most awkward angle. The approach to the canal is crooked and unsightly.

Now that the canal has been made navigable, these defects should be remedied and this can only be done by removing the existing bridge altogether.

On receipt of your instructions, I will have an estimate prepared.

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ENCLOSURES.

*Letter*—from the Superintending Engineer, II Circle.
*To*—the Collector of Kistna.
*Dated*—the 16th June 1905.
*No.*—85 M.

I have the honour to forward a plan I have prepared showing three different methods of dealing with the bridges and roads at the heads of the Ellore and Ryves' canal shown in blue, brick red and lake red, respectively, with a request that you will favour me with your opinion as to which you would recommend.

2. I enclose the Chief Engineer's latest orders on the subject for your perusal.

3. If the present bridge over the Ryves' canal is retained it will be altered and raised to the level of that over the Ellore canal.

4. In my opinion the bridge over the Ryves' canal must be demolished. The approach to the Ryves' canal which is now a navigable canal, is most awkward and unsightly. The method shown in lake red may therefore be condemned.

5. The method shown in blue is for a skew-girder bridge. It is not a good position for boats trying to enter Ryves' canal.

6. The method shown in brick red is, in my opinion the best. The bridge does not obstruct the approach to the Ryves' canal which can be straightened out and improved as shown. The bridge can be either an iron girder or an arched bridge. The latter would be better from an architectural point of view.

The favour of an early reply is requested.

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*Letter*—from the Collector of Kistna.
*To*—the Superintending Engineer, II Circle.
*Dated*— the 26th June 1905.
*No.*—2162-D./G1.

I have the honour to reply to your No. 85, dated 16th June 1905.

2. The present Ryves' canal bridge must be raised now that the Ryves is a navigable canal. Whether this can best be done by raising the present bridge or constructing an entirely new one is a professional matter on which I am not competent to express an opinion.

3. Traffic is very much congested on the length of road passing over the Ryves' and Ellore canal bridges and over the railway, and, as years pass by, it will become more and more congested because it will increase. As matters are at present it is generally dangerous and often very tedious to walk, ride or drive along the roads. For this reason I am of opinion that it is essential to keep the Ryves' canal bridge either on its present site or on a site parallel to, and immediately to the north or south of, the present site, so that the whole road over the two canals and the railway can ultimately be in a straight line when funds are available for altering the Ellore canal bridge. The heavy traffic can never be successfully dealt with unless it is kept in a straight line and for this reason I cannot agree with you that the brick red line shown in your

plan is a good alignment. The angles of approach to the bridge would be more awkward than they are now and the brick red centre line of the bridge could never be extended over the Ellore canal and railway into the town. I do not think we need despair of ever getting sufficient money to build a new bridge over the Ellore canal. The Municipality owns a lot of valuable land, the sale proceeds of which could be spent in this very desirable improvement. The District Board would probably be willing to contribute as the bridge is on the main Hyderabad road which was maintained by the District Board before Bezwada became a Municipality and is still being maintained by the District Board in the form of an annual contribution to Municipal funds. Government would also probably be willing to give a grant.

4. One reason why you prefer the brick red alignment for the Ryves' canal bridge is probably that it is at right angles to the canal but I think this advantage might be sacrified to the straightening of the road way.

5. I would urge that in altering or reconstructing the Ryves' canal bridge the road way be made if possible twice as broad as the present road, or at any rate half as broad again. I would also suggest that, if a new bridge be built, it be placed slightly to the south of the present one so that its centre line may approximate to the centre line of the road to the head works which will be the line of the bulk of the traffic.

6. I return your plan.

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## VIII

### Memorandum No. 2958, dated 23rd September 1905.

With reference to his letter No. 210 W., dated 10th August 1905, to the address of the Chief Engineer, Public Works Department, the Superintending Engineer, II Circle, is informed that unless the District Board of Kistna and the Bezwada Municipality are willing to contribute towards the Collector's proposals, expenditure should be confined to the necessities of the case, viz., the raising of the existing bridge over the Ryves' canal so as to give ample headway for boats. Before the District Board and the Municipality can be called upon to contribute, it is necessary that the cost of the Collector's scheme should be known. The Superintending Engineer is accordingly requested to be so good as to prepare and submit estimates in alternative—.

(*a*) for carrying out the Collector's proposals ; and

(*b*) for effecting the improvement absolutely necessary for the bridge over Ryves' canal as stated above.

A. H. GARRETT,
*Chief Engineer for Irrigation.*

To the Superintending Engineer, II Circle.

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## IX

*Letter*—from Lieut.-Col. W. M. ELLIS, R.E., Superintending Engineer, II Circle.
*To*—the Chief Engineer for Irrigation (through the Collector of Kistna).
*Dated*—Bezwada, the 10th/14th May 1908.
*No.*—50 I.

With reference to your No. 2958, dated 23rd September 1905, I enclose a note on the subject of the proposals made for bridges across the heads of Ryves' and Ellore canals and plans and estimates for two new bridges one across Ryves' and one across Ellore canal prepared by the Executive Engineer, Kistna Central Division.

I do not recommend either of these for sanction, but I think it desirable before any further design is made to lay the whole matter before you for orders as I believe the information now available will allow a definite decision to be come to.

A third estimate for raising the present Ryves' canal bridge which was prepared some years ago is also sent; this raising includes widening the roadway.

I am strongly against this work which will never give a satisfactory bridge being carried out.

The note I put up will make my views clear and I am sending the whole through the Collector, Kistna, for remarks. That officer has been consulted verbally and has suggested an improvement to Ellore bridge approach from the Ryves' canal end which could be carried out without difficulty and would be provided for in an estimate for providing foot-ways, if the proposal to provide those is approved.

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ENCLOSURES.

(i)

*Note by the Superintending Engineer, II Circle, on proposals for new bridges to carry Hyderabad-Bezwada road over Ryves' and Ellore canals.*

With reference to Memorandum from the Chief Engineer for Irrigation, No. 2958 of 23rd September 1905 directing the submission of alternative estimates—

(*a*) For carrying out the Collector's proposals.

(*b*) For effecting the improvement absolutely necessary in the bridge across Ryves' canal.

2. The Collector's proposals were to build a new bridge over Ellore canal and in a straight line either a new or altered bridge over Ryves' canal raising the roadway of the latter, so as to do away with the slope from the south which now leads on to it and these proposals are materially those for which estimates were submitted with No. 349-I., dated 12th November 1904.

3. It was recognized in the Chief Engineer, Public Works Department Note, No. 96-C. of 6th January 1905 that the building of a new bridge across Ellore canal was not a necessity although it would be a convenience.

I do not think that a new one is called for.

4. On the matter of what he desired, the Collector was addressed by Mr. Medlicott when Superintending Engineer, in letter No. 85 M., dated 18th June 1905, and replied in letter No. 2162, dated 26th June 1905, copies of which letters with reference plan " × " together with the Superintending Engineer's No. 210 W., dated 10th August 1905, to the Chief Engineer, Public Works Department, are enclosed.

The Superintending Engineer (Mr. Langston) in his No. 191-K.C., dated 5th July 1906 (copy enclosed), instructed the Executive Engineer to adhere to the present site for the Ryves' bridge and to prepare three estimates—

(*a*) For a new bridge over Ellore canal in line with Ryves' canal bridge.

(*b*) For a new bridge over Ryves' two spans and of girder type and with piers properly faced to the current.

(*c*) To raise the existing Ryves' bridge so as so allow sufficient head-way for navigation as an alternative to (*b*).

5. As a fact the estimates submitted by the Executive Engineer do not comply with the instructions. He submits an estimate for (*a*) amounting to Rs. 28,600 for a 66 feet single span skew girder bridge across the Ellore canal. The width of roadway is 25 feet and no foot-paths are provided.

I think this is a mistake—20 feet cartway and two foot-paths of 3½ feet would be equally cheap and I consider more convenient.

The Executive Engineer also submits an estimate for (*b*) but as he has left the piers as before at right angles to the centre line of roadway instead of parallel to the canal axis the design and estimate cannot be approved.

The estimated cost of the bridge is Rs. 36,200 and the revision to the skew type and provision of foot-ways and cart road of 20 feet would probably raise the cost to Rs. 39,000.

No estimate for (*c*) has been prepared as an alternative to (*b*), but an estimate for this was prepared by Mr. Romilly when Executive Engineer, Kistna Northern Division, in 1904 which amounted to Rs. 25,600 for a bridge 20 feet roadway without foot-paths. The addition of foot-paths would raise the cost to about Rs. 29,000 which may be taken as the cost of raising Ryves' bridge on existing piers and abutments and providing girders, 20 feet cart road and two foot-paths.

Of this sum the Municipality might be expected to pay 33 per cent., say Rs. 10,000 for the widening of the bridge and improving the approaches. The present width is 18 feet and there are no foot-paths.

As, however, the alignment across the current of the two piers and abutments of the existing bridge are a great obstruction to navigation, I think it would be a great mistake to alter this old bridge which can only be a thoroughly unsatisfactory job.

6. As I do not quite concur in the opinions expressed on the subject of the cause of congestion of traffic and the proposed cures, I offer the following statement of my views.

It is at, and in the immediate vicinity of, the level crossing on the railway that traffic is congested. A study of the plans will show that approaching this one level crossing, the width of which suffices conveniently for two lines of wheeled traffic only; there are three roads on the south-west side and two on the north-east of which five roads, four carry a lot of traffic.

There is a certain amount of open road space just clear of the gates on the south-west side but none on the north-east side where the lines of the traffic from the Railway goods station and from the Masulipatam and Hyderabad directions even when the Railway gates are open require careful and skilled handling to prevent a block, which skilled direction is not available.

When the gates are shut, blocks must occur by the various lines of traffic which converge to meet at this point and no amount of straightening the approach from the south-west side will materially affect this.

Widening the bridges will not, I think, improve matters greatly as there is ample room for two lines of cart traffic now but foot passengers and fast traffic are inconvenienced.

I consider the bridges require ample room for two lines of cart traffic, say 20 feet roadway and in addition foot-ways on each side.

As regards the great stress placed by Mr. Parsons on a straight approach, I fail to see the great advantage to be derived from this. If the approach was such that vision was obstructed and one could not see one bridge and the intervening roadway from the other, I would concur but this is not so.

As a fact in my opinion the space between the two bridges which is fairly open and allows of traffic passing is of the nature of an open space between two short defiles and such a space facilitates traffic.

If, for instance, the bridges were close together and on the same axial straight line with each other I hold the block would be far worse by the diminution of the clear space between the bridges.

If a similar open space as is at present available between the bridges were available and the bridges were axially on the same straight line, the arrangement would no doubt be better especially for fast traffic, but the improvement for slow traffic would not be great.

So long as a narrow passage like a railway crossing which is being constantly barred to traffic must carry the traffic of the five roads which converge at this point, so long are serious blocks in traffic bound to continue.

It is the railway crossing and converging roads and not the bridges which are the cause of the blocks of traffic and it is the blocks which obstruct the bridge road-way and not the inadequate roadway which causes the blocks.

On account, however, of the blocks it is most desirable to have separate foot-ways for the bridges and thus wider roadways to provide for these are desirable.

Further the approach to the Ryves' bridge from both sides is down hill and from the south-east side rather steep and round a curve which obstructs view.

Thus it appears that from the road traffic point of view what is required is :—

(1) To raise Ryves' bridge and to provide footways and improve the approaches. The bridge to be raised to roadway level about 68·0, the level of roadway of existing Ellore bridge being 66·8.

(2) To provide foot-ways to Ellore Canal bridge by widening the roadway with foot-paths projecting out over the present face walls.

This would not cost much.

7. From a navigation point of view Ryves' bridge must be raised to give a clear head-way of 11 feet over maximum water level (11 feet in main canal). This may necessitate raising the road level to + 68.

The piers and abutments of the present bridge are such as to render navigation difficult and dangerous while the work causes an obstruction to the free flow of the canal.

As regards the position of the present bridge I agree with Mr. Langston that it is a good one but if a new bridge is to be built I would shift it to a position just above the present one in order that traffic might not be interfered with during construction and the approach from the south-east a little straightened. The new bridge position would then be as shown in yellow on plan X.

The roadway would be raised to + 68 about one foot above the level of roadway of the existing Ellore canal bridge instead of 69·14, the rail level which was proposed by the Executive Engineer, Kistna Central Division, on the supposition that a new bridge across Ellore canal would be built and the approach to the bridge from the south-west would be nearly level instead of 1 in 30 as at present. The cost of the proposal would be about Rs. 39,000 and having in view that the improvement of the canal bridge for navigation is imperative, I consider it would be fair for the whole except the Rs 10,000 before mentioned to be borne by Irrigation funds.

8. The improvement of Ellore bridge to give foot-ways on either side has not been estimated, but would not exceed Rs. 3,000 it is believed and this improvement should be carried out from Municipal funds or at any rate not at the cost of irrigation.

9. To recapitulate —

(*a*) The cost of a new bridge across Ellore canal with roadway 20 feet wide and two foot-paths of 3½ feet will be about Rs. 28,600.

(*b*) The cost of a new bridge across Ryves of above road widths two spans with skew piers and abutments will be about Rs. 39,000.

(*c*) Raising on old piers and abutments the existing Ryves' bridge and widening roadway as above Rs. 29,000.

I recommend that (*b*) be carried out in the interests of navigation, but that a contribution of Rs. 10,000 be asked from Provincial funds or Local Bodies.

I also consider that the existing Ellore canal bridge should be widened to provide footpaths on each side which should be done by Local or Provincial funds. The cost would be about Rs. 3,000.

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(ii)

*Memo.*—from the Superintending Engineer, II Circle.
*To*—the Executive Engineer, Kistna Central Division.
*Dated*—the 5th July 1906.
*No.*—191 K.C.

Has the honour to forward herewith a tracing of the head of Ryves' canal together with copies of Collector's No. 2162–D/Gl. of 1905, dated 26th June 1905, this office No. 210-W., dated 10th August 1905, and Chief Engineer's reply No. 2958, dated 23rd September 1905. From the Chief Engineer's letter it will be seen that the absolutely necessary work which has to be done is to raise the Ryves' canal bridge to admit of free navigation underneath it. But what is really wanted, and this is what we must try all we can to get sanctioned with the help of contributions from the Municipality and District Board, is a new bridge over the Ellore canal as nearly as possible in a line with the Ryves' canal bridge.

The present line of Ryves' canal bridge, *i.e.* of the roadway, is as good as it need be and a blue pencil line has been marked out on the tracing as a good line for the proposed new bridge across Ellore canal. Though not in a straight line with Ryves' canal bridge it is near enough and such a line will be a vast improvement on the present state of affairs.

2. The piers of the Ryves' canal bridge are at a wrong angle and interfere with the free flow of water. The left arch always silts up and becomes useless. The estimates will have to be prepared for this bridge—

(1) for merely raising the piers and arches, giving increased width of roadway if it is possible,

(2) for an entirely new girder bridge with new abutments and a central pier built in the line of flow of the water, extending the nose between Bundar and Ryves' canals and cutting off the nose between Ryves' and Ellore canals to make the approach to Ryves' canal better than it is at present. It is not possible to draw an accurate line for this unless the centre line of main canal can be marked on the tracing.

3. This latter estimate will be the alternative one to be carried out along with the new bridge at the head of Ellore canal which should also be a girder bridge and both bridges should allow for a roadway 25 feet wide.

4. The Executive Engineer is requested to prepare these estimates as soon as possible, so that no time may be lost in communicating with the President, District Board, with regard to contributions from Local and Municipal funds and with Government. The raising of Ryves' canal bridge is an urgent matter.

(iii)

*Report to accompany the estimate for alterations and improvements to the bridge at head of Ryves' canal.*

| | RS. |
|---|---|
| Amount of estimate ... ... ... .. ... ... ... | 25,600 |

It is proposed to raise the piers and abutments of the existing bridge and put girders on them as ordered by the Superintending Engineer, II Circle, in his letter No. 640 K.N., dated 16th November 1903, and the design and estimate for improving the same have accordingly been prepared and submitted for sanction.

The design has generally been approved by the Superintending Engineer, II Circle, in his letter No. 198 K.N., dated 10th June 1904. Calculations for the girders also accompany the estimate.

The road level of the bridge has in the proposed arrangement been increased from + 62·81 to + 70·00 to allow sufficient headway for navigation. A headway of 12 feet has been provided.

A lump sum of Rs. 16,060 has been provided in the estimate as cost of girders including delivery at Bezwada railway station as per figure given by Messrs. Richardson & Cruddas, Bombay.

*Specification.*

The different kinds of work will be carried out in accordance with the standard specification of the Madras Presidency.

A. G. ROMILLY,
*Executive Engineer, Kistna Northern Division.*

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(iv)

*Report to accompany the estimate for constructing a girder bridge at the head of Ryves' canal two spans of 63 feet each.*

| | RS. |
|---|---|
| Estimate ... ... ... ... ... ... ... ... ... | 36,200 |

Under instructions from the Superintending Engineer in his No. 191 K.C., dated 5th July 1906, it is now proposed to demolish the existing bridge and to rebuild a girder bridge of two spans of 63 feet each with a pier in the centre.

The design is the same as the one for Ellore canal but this is an ordinary bridge and not skew.

*Foundations.*—The foundation consists of solid masonry roughstone in surki mortar taken down to level + 35·00 with one in six batter on each side right through abutments, wings, etc., leaving an offset of 6 inches on either side of masonry in superstructure from the foundations at + 41·00 which is the floor level, the soil being clay.

*Superstructure.*—This will be of roughstone in chunam with faces neatly dressed and joints pointed with surki mortar. The copings of parapets, pedestals, tow-paths, etc., will be of cut-stone finely dressed and laid in ordinary mortar, the roadway being the same as for the Ellore bridge.

*Girders.*—These are wrought iron plate girders spaced 7 feet from centre to centre. The centre two girders will be 4 feet deep and are sufficiently strong with 17 inches wide flanges $\frac{1}{2}$ inch thick, angles $4'' \times 4'' \times \frac{1}{2}''$ and $\frac{3}{8}''$ web to bear the maximum load of about 55·6 tons. The girders are designed with fair margin of safety for all stresses, compression, tension and shear as may be found from the calculations herewith attached.

The end girders are 4 feet deep and are strong enough to bear the maximum load of 45·5 tons.

A separate estimate is made for the cost of girders including delivery at Bezwada.

Provision is also made in the estimate for raising the road on both sides up to level + 69·14.

The rates allowed in the estimate are as per schedule of rates of this division and detailed data of rates has been submitted for other items not found in the schedule; and all the works will be executed in accordance with the standard specification in this Presidency.

M. BROWN,
4*th September* 1907. *Executive Engineer, Kistna Northern Division.*

(v)

*Report to accompany the estimate for constructing a skew girder bridge at the head of Ellore canal one span of 66 feet.*

| | RS. |
|---|---|
| Estimate ... ... ... ... ... ... ... ... ... | 28,600 |

The existing bridge at head not being in a line with that across the Ryves' canal, causes much inconvenience to traffic, it is therefore proposed under instructions from the Superintending Engineer in his letter No. 191 K.C., dated 8th July 1906, to demolish the present bridge and to rebuild a skew girder bridge a little below the existing one in line with the Ryves' canal bridge as shown in the site plan accompanying. The bridge is proposed to be built with road level + 69·14 which is the top level of the rails of the road crossing, thus allowing a sufficient headway for free navigation.

*Foundations.*—This consists of concrete hard broken stone in surki mortar, prepared in suitable proportions with mortar sufficient to fill in the voids generally taken as 40 per cent. of the whole, laid 3 feet deep with one foot offset beyond masonry up to level + 38·00; the soil being clayey, above this is built of roughstone in surki mortar to level + 41·00 all over wings and abutments, which is the floor level of the bridge. The floor is made of 2 feet roughstone masonry resting on a bed of one foot of concrete.

*Superstructure.*—This will be of roughstone in ordinary mortar, the mortar prepared of two of sand and one lime free from ash and all other impurities and well ground to the required consistency. The stones will have to be laid in mortar after dust is well cleaned. The faces of wings, abutments and tow-paths and parapets will be neatly dressed to present a well finished appearance and the joints will be pointed with surki mortar.

*Roadway.*—The roadway will be 25 feet wide clear between guard stones and consist of road metal 9 inches thick well rammed, covered with 3 inches gravel; the whole resting on steel trough flooring plates of sufficient thickness to bear the metalling.

*Girders.*—These are wrought iron plate girders spaced 7 feet from centre to centre and laid on cutstone beds one foot thick. The centre two girders are 5 feet deep with flange plate 18 inches wide and ½ inch thick, angles 4″ × 4″ × ½″ and web ⅜ inch thick, these two central built up girders to bear maximum load of nearly 65·6 tons. The girders designed are sufficiently strong with fair margin of safety for stresses in compression, tension and shear as may be seen from the calculations herewith attached.

The side girders are 4 feet deep and are also sufficiently strong to bear the maximum load of about 53·6 tons.

A separate estimate is made for the cost of girders including delivery at Bezwada.

Provision is also made in this estimate for diverting and raising the road to level + 69·14 on both sides. (This does not include any raising with reference to Ryves.) The rates allowed in the estimate are as per schedule of rates in the Division and detailed data has been submitted for other items not found in the schedule and all works will be executed in accordance with the standard specification in this Presidency.

M. BROWN,
*Executive Engineer, Kistna Northern Division.*

*4th September* 1907.

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X

**Endorsement No 2146, dated 3rd June 1908.**

Forwarded to the Collector of Kistna for favour of remarks as the letter is addressed through him to the undersigned.

(By Order.)

T. W. S. SMYTH,
*Asst. Chief Engineer for Irrigation.*

To the Collector of Kistna.

## XI

### Memorandum No. 2147, dated 3rd June 1908.

With reference to letter No. 50 I., dated 10th May 1908, from the Superintending Engineer, II Circle, the Chief Engineer for Irrigation has the honour to state that his report on the proposals for constructing bridges across the heads of the Ryves' and the Ellore canals, addressed to the undersigned through the Collector of Kistna, having been received in this office direct, it has been sent to the Collector for remarks.

(By Order.)

T. W. S. SMYTH,
*Asst. Chief Engineer for Irrigation.*

To the Superintending Engineer, II Circle.

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## XII

*Letter*—from R. MORRIS, Esq., I.C.S., Collector of Kistna.
*To*—the Chief Engineer for Irrigation.
*Dated*—the 10th June 1908.
*No.*—1888-Gl.

In returning the letter to the address of the Secretary to Government, Public Works Department, from the Superintending Engineer, II Circle, Public Works Department, Bezwada, No. 50 I., dated 10th March 1908, and its enclosures, received with your endorsement No. 2146, dated 3rd June 1908, on the subject of the alterations necessary to the bridges over the Ellore and Ryves' canals on the Masulipatam-Bezwada-Haiderabad road at Bezwada, I have the honour to state that while I should like to see both bridges raised and widened, I agree that to do so would be costly. No aid could be expected from the District Board, as Bezwada is excluded from the Kistna Local Fund district, and the expenditure of money from the District Fund on objects outside the (Local Fund) district except in special cases with the express sanction of the Governor in Council would, under section 95 of the Local Boards Act, be illegal. Moreover the District Board has no manner of concern with the facilities for traffic afforded within the Municipality of Bezwada. The Municipality itself is not a rich one, and only a small contribution could be expected from Municipal Funds. Therefore unless the Government are prepared to give a grant from Provincial Funds, or to direct the execution of the whole work from Irrigation (Imperial) Funds, the scheme must be confined to what is at present absolutely necessary.

2. Before addressing the Government Colonel Ellis consulted me as to my views as to what should be done, and on the assumption that it is not feasible, with regard to the funds available, to raise and widen both bridges, I concurred entirely in the proposals contained in his note, undated, but typed on the 13th May 1908, and marked as pages 24–29 in the file of papers. I do not however concur with him that any part of the cost should be borne by Local Funds. If the Government do not consider that the cost should be debited entirely to Provincial or Imperial Funds, the portion of the cost not so borne should be debited to Municipal Funds. It does not appear necessary for me to discuss now what share of the cost, if any, should be borne by Municipal Funds.

3. The modification to which the Superintending Engineer alludes in the last paragraph of his letter under reference is the curving of the wing wall of the northern wing wall on the eastern side of the bridge over the Ellore canal so as to make the turn into the road there less sharp. I understand Colonel Ellis to concur with me as to the desirability of this.

## XIII

*Letter*—from R. Morris, Esq., I.C.S., Collector of Kistna.
*To*—the Chief Engineer for Irrigation.
*Dated*—the 13th June 1908.
*No.*—Dis. 1973.

In my letter Dis. No. 1888 Gl., dated 10th June 1908, about the Bezwada canal bridges I regret that I omitted to add that it is also very necessary that the railway crossing near them should be widened to at least half its present width again, if not indeed doubled, so as to relieve the congestion of traffic.

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## XIV

**Memorandum No. 240-2 L/O., dated 13th August 1908.**

The Superintending Engineer, II Circle, reported that when the supply of water in the Ryves' canal at Bezwada was full, boats could not pass under the bridge. He, therefore, proposed that in order to give a clear headway over the maximum water level in the canal for purposes of navigation, the bridge should be raised.

2. The Collector of Kistna while agreeing with the Superintending Engineer, pointed out that in the interests of the heavy cart traffic at Bezwada, the bridge over the Ellore canal also should be raised to the same level as the bridge over the Ryves' canal and that the roadway over the two bridges should be widened. He accordingly recommended the construction of—

(1) a new bridge over the Ellore canal, and

(2) in a straight line a new or altered bridge over the Ryves' canal with broader roadway, providing for raising the roadway in order to do away with the slope from the south now leading up to it.

3. The cost of the above proposals is estimated as follows :—

| | RS. |
|---|---|
| (i) Construction of a new bridge across Ellore canal with roadway 20 feet wide and two footpaths of $3\frac{1}{2}$ feet on either side ... | 28,600 |
| (ii) Construction of a new bridge across Ryves' canal of the above road-widths two spans with skew piers and abutments ... | 39,000 |
| (iii) Raising on old piers and abutments the existing Ryves' bridge and widening roadway as above ... ... ... ... | 29,000 |

4. Inquiries show that the demands of the Irrigation Department can be satisfied completely by raising the bridge over the Ryves' canal at an estimated cost of about Rs. 29,000 and that the cost of providing additional roadway over this bridge and the construction of a new bridge over the Ellore canal on the same level with the additional roadway, if they are considered necessary for its cart and foot traffic, should properly be debited to the Bezwada Municipality. The cost of these works is estimated at about Rs. 38,600. But the Superintending Engineer points out that the needs of cart and passenger traffic would be sufficiently met by the provision of additional roadway over the two bridges across the Ryves' and Ellore canals by means of footpaths on either side at a total estimated cost of Rs. 13,000.

5. The Municipal Council of Bezwada is requested to state at an early date whether it considers it necessary to effect these improvements in the interests of vehicular and foot traffic over the bridges, and if so whether the Municipal Council is prepared to provide the funds, estimated at Rs. 13,000, necessary for carrying out these additional works.

H. D. Taylor,
*Secretary to Government.*

To the Chairman, Municipal Council, Bezwada (through the Collector of Kistna).

## XV

*Letter*—from M.R.Ry. T. V. NARASAYYA PANTULU Garu, Chairman, Municipal Council, Bezwada.
*To*—the Secretary to Government, Local and Municipal Department (through the Collector and the Divisional officer, Bezwada).
*Dated*—Bezwada, the 3rd December 1908.
*No.*—1849.

With reference to Reminder No. 1 on Memorandum No. 240–2 L/O of the 13th August 1908, I have the honour to inform you that I have already replied the reference through the Collector and the Divisional officer—*vide* this office No. 1334 of the 24th September 1908.

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*R.C. No.* 347 *L. & M., dated* 18*th December* 1908.

Forwarded.

2. The papers will be submitted on receipt of further information called for from the Chairman in this office R.C. No. 347 L. & M. of 1908, dated 26th November 1908. He has again been reminded.

E. SCOTT,
*Collector.*

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## XVI

*Letter*—from M.R.Ry. T. V. NARASAYYA PANTULU Garu, Chairman, Municipal Council, Bezwada.
*To*—the Secretary to Government, Local and Municipal Department (through the Collector and the Divisional Officer, Bezwada).
*Dated*—the 22nd September 1908.
*No.*—1334.

With reference to Government Memorandum No. 240-2 L./O. of the 13th August 1908, communicated through the Collector and the Divisional Officer with their endorsements Nos. N. Dis. C. No. 294/M. of 20th August 1908 and N. Dis. No. 1194/H. of 27th August 1908, respectively, I have the honour to submit herewith a copy of the resolution passed by the Council at its meeting held to-day on the subject.

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ENCLOSURE.

*Proceedings of the Municipal Council, Bezwada, dated 22nd September* 1908.

Read Government Memorandum No. 240-2 L./O. of 13th August 1908, requesting to be informed if the Municipal Council can pay Rs. 13,000 for providing footpaths on either side of Ellore and Ryves' canal bridges for the convenience of foot passengers.

*Resolution No.* 2.—As it is reported that the Railway Department has under contemplation to have an overbridge built in the locality the Council humbly submits that the proposal may be kept in abeyance till the matter (the construction of the overbridge) is finally disposed of. In case the work is to be proceeded with immediately, the Council is willing to pay the amount in yearly instalments of Rs. 2,000.

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*N. Dis. No.* 1618 *Gl., dated* 28*th September* 1908.

Submitted to the Collector of Kistna.

J. M. TURING,
*Sub-Collector.*

*Extract from the Proceedings of the Municipal Council, Bezwada, dated 17th December* 1908.

Read letter No. 347/L. & M. of 26th November 1908, from the Collector, Kistna, requesting to replace before the Council the subject of providing footpaths in the sides of bridges over Ellore and Ryves' canals and to report the result.

*Resolution No.* 3.—If the construction of overbridge does not necessitate the alteration in the bridges over Ellore and Ryves' canals the work may be proceeded with. The amount necessary to be spent on this account will be paid in instalments of Rs. 2,000 a year as already agreed upon by the Council in its resolution No. 2, dated 22nd September 1908.

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*Dis. No.* 5532 *R./Gl., dated 4th January* 1909.

Forwarded with a copy of the Municipal Council's resolution, dated 17th December 1908.

2. It was pointed out to the Council that the construction of the overbridge referred to in the Council's resolution, dated 22nd September 1908, did not necessitate any alteration in the bridges over the Ellore and Ryves' canals.

E. SCOTT,
*Collector.*

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## XVII

*Letter*—from F. D. FOWLER, Esq., Secretary to Government, P.W.D. (Ry.).
*To*—the Agent, Madras and Southern Mahratta Railway.
*Dated*—the 5th March 1909.
*No.*—118 Ry.

I am directed to refer to paragraph 2 of G.O., No. 1261 Ry., dated the 22nd July 1902, in which the Agent and Manager of the late Madras Railway was requested to expedite the submission of the plans and estimates for the rearrangement of the Bezwada station yard in connection with the provision of an overbridge across the station yard, which was ordered to be constructed in G.O., No. 2094 Ry., dated the 13th December 1892.

2. Since then the question of raising the bridges over the Ellore and Ryves' canals referred to in paragraph 3 of the first-quoted Government Order has been under the consideration of the Superintending Engineer, II Circle, and the Collector of Kistna. It has now been decided by Government in the Irrigation Department to construct a new bridge across the Ryves' canal of 20 feet road-width, 2 spans with skew piers and abutments, at a cost of about Rs. 39,000 and (2) to widen the Ellore canal bridge so as to provide a footpath on each side at a cost of about Rs. 3,000.

3. In the scheme for the rearrangement of the Bezwada station yard submitted by the Agent and Manager of the late Madras Railway in 1906, provision was made for (1) road overbridge at Rs. 59,763 with approach road to it at Rs. 39,033, and (2) a foot overbridge at Rs. 38,274. With reference to the proposals made in the provisional estimate for overbridge and approach road, I am to request that you will kindly let me know for the information of Government, what is now intended to be done, and send a plan of the arrangements proposed.

4. I am also to request that the matter may be discussed with the Government Inspector at the forthcoming inspection of the North-East Line.

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## XVIII

*Letter*—from A. R. ANDERSON, Esq., Agent, Madras and Southern Mahratta Ry.
*To*—the Secretary to Government, Public Works Department (Railway).
*Dated*—the 24th March 1909.
*No.*—351/7369.

[Your No. 118 Ry., dated 5th March 1909.]

Since the question of raising the bridges over the Ellore and Ryves' canals referred to in G.O., No. 1261 Ry. of 22nd July 1902, has now been considered and it has been decided by Government in the Irrigation Department to construct a new bridge across the Ryves' canal and to widen the Ellore canal bridge, I have the honour to put forward for the consideration of Government that the opportunity should be

taken of improving the canal crossings and railway crossings simultaneously. I would therefore beg to propose that a scheme providing for such improvements should be prepared by Government and that I may be advised what proportion of the cost of the same Government consider this company should be called upon to bear in order that I may be in a position to deal finally with the question.

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### XIX

*Letter*—from W. NATHAN, Esq., Secretary to Government, P.W.D. (Railway).
*To*—the Agent, Madras and Southern Mahratta Railway.
*Dated*—the 6th April 1909.
*No.*—199 Ry.

With reference to your letter No. 351-7369, dated the 24th March 1909, I am directed to request that, as asked for in my letter No. 118 Ry., dated the 5th March 1909, you will kindly state how the case stands at present, and send a plan embracing the whole of the Bezwada yard and the sites of the proposed overbridges.

2. The alterations are now being considered with reference to the overbridge question only; the plan need therefore show no details of the railway yard; it will suffice if it indicates the railway boundaries and the surrounding roads and existing level-crossings in the neighbourhood, and has the proposed alterations to roads, etc., marked on it, so that it may be judged whether the public convenience as regards roadways has been duly provided for. This is specially necessary as some confusion seems to have arisen as to whether it is contemplated to provide an overbridge *across* the railway yard, as well as one at the *south end* of it.

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### XX

*Letter*—from the Agent, Madras and Southern Mahratta Railway.
*To*—the Secretary to Government, Public Works Department (Railway).
*Dated*—Madras, N.E., the 7th May 1909.
*No.*—351-W./689/10843.

With reference to your letter No. 199 Ry., dated the 6th ultimo, I have the honour to send herewith plans Nos. 5660/11/1 and 6161-H showing our proposals. These include a road overbridge for vehicular traffic at the site of the level-crossing A—*vide* plan No. 6161-H—and a foot overbridge 15′ wide at C, the level-crossings at B and D being closed.

A right of way for pedestrians only will be given over the overbridge at C and along the road leading from C to the Ellore canal at E, and vehicular traffic will be permitted to use a road from the Ellore canal bridge at E to the level-crossing at A in lieu of the two level-crossings at B and D.

With regard to the approaches to the proposed new overbridge at A, it has been proposed to build new bridges over both the Ellore and Ryves' canals, and in your letter No. 118 Ry., dated 5th March 1909, you advised me that the construction of a new bridge over the Ryves' canal and the widening of the Ellore canal bridge had been decided upon by Government in the Irrigation Department.

I understand, however, that the construction of a new bridge over the Ellore canal is not considered necessary by the Superintending Engineer, II Circle, either in the interests of irrigation or navigation; but since this is a necessary part of the scheme for improving the approaches to the overbridge and its desirability from a point of public convenience is very great, its inclusion in the proposals appears essential.

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**Order—No. 278 I., dated 30th June 1909.**

The papers read above relate to the question of raising and improving the road bridges over the Ellore and Ryves' canals at Bezwada. In January 1902 the Superintending Engineer, II Circle, Colonel C. C. Rawson, R.E., brought to notice that when there was full supply of water in the Ryves' canal at Bezwada boats could not

pass under the bridge. He therefore proposed that, in order to give a clear headway over the maximum water-level in the canal for purposes of navigation, the bridge should be raised. It was stated that the raising of this bridge would necessarily involve the raising of the bridge over the Ellore canal also.

2. Colonel Rawson's proposal having been approved, the Superintending Engineer, Mr. O'Connell, submitted in November 1904 plans and estimate (*a*) for raising the bridge over the head of Ryves' canal and (*b*) for building a new bridge across the Ellore canal in a straight line with it. Mr. O'Connell drew attention to G.O., No. 1261 Ry., dated 22nd July 1902, by which an overbridge across the Bezwada station yard was ordered to be constructed but had not been put in hand. He pointed out that, for want of an overbridge, all the road traffic was diverted over the two canal bridges and that the railway level-crossing near the canal bridges caused congestion of traffic. The Superintending Engineer therefore recommended that the cost of the proposed works should be borne by the Railway, the Public Works Department, the District Board and the Municipality.

3. The Collector of Kistna stated that the District Board had no interest in the work, while the Municipality could not contribute towards the cost of the works owing to its limited resources. The Consulting Engineer for Railways also considered that no case could be made out for making the Railway pay a share. The Superintending Engineer was therefore asked to reconsider his proposals substituting a girder, if possible, for one of the spans of Ryves' bridge, the pier being reinforced to enable it to withstand the thrust of the arch, and doing away with the proposed new bridge over the Ellore canal, which was not a necessity though a convenience.

4. In reply, the Superintending Engineer forwarded copies of correspondence with the Collector who pointed out that, in the interests of heavy cart traffic at Bezwada, the bridge over the Ellore canal also should be raised to the same level as the bridge over the Ryves' canal and that the roadway over the two bridges should be widened. He accordingly recommended the construction of—

(1) A new bridge over the Ellore canal, and

(2) in a straight line, a new or altered bridge over the Ryves' canal with broader roadway, providing for raising the roadway in order to do away with the slope from the south leading up to it.

The Superintending Engineer (Mr. Medlicott) concurred with the Collector.

5. The Superintending Engineer was informed in Chief Engineer's Memorandum No. 2958, dated 23rd September 1905, that unless the District Board and the Bezwada Municipality were willing to contribute towards the Collector's proposals, expenditure from Irrigation funds should be confined to the necessities of the case, *viz.*, the raising of the existing bridge over the Ryves' canal so as to give ample headway for boats. As it was necessary that the cost of the Collector's scheme should be known before the District Board and Municipality could be called on to contribute, the Superintending Engineer was asked to submit estimates (1) for Collector's proposals and (2) for raising the bridge over the Ryves' canal as stated above.

6. In May 1908 the Superintending Engineer (Colonel Ellis), while submitting the estimate called for, remarked that in view of the fact that the congestion to traffic occurred at, and in the immediate vicinity of, the railway level-crossing and that the block to traffic was due to the closing of the railway gate and the convergence of five roads and not to the inadequate roadway over the bridges, the straightening of the approach on the south-west side recommended by the Collector would not be an advantage. He therefore recommended (1) the construction of a new bridge of two spans with skew piers across the Ryves' canal on a site just above the present one with roadway raised to + 68 and providing for a 20-feet cart-way and foot-paths at an approximate cost of Rs. 39,000, the Provincial or Local funds contributing Rs. 10,000 towards the cost of widening the bridge and improving the approaches, (2) the provision of foot-paths on the existing bridge over the Ellore canal at the expense of Provincial or Local funds at an estimated cost of Rs. 3,000. The Collector of Kistna, while thinking that both the bridges should be raised and widened, was of opinion that unless Government were prepared to give a grant from Provincial

funds, or direct the execution of the works from Irrigation funds, the scheme should be confined to what was absolutely necessary, as no aid could be expected from the District Board without the express sanction of Government and as Municipal funds could only contribute a small portion of the cost. The Collector accepted the proposals of the Superintending Engineer, except so far as related to the contribution from Local funds, and pointed out that the portion of the cost not borne by Provincial or Imperial should be debited to Municipal funds.

7. The Municipal Council of Bezwada which was addressed on the subject agreed that the proposed improvements were necessary in the interests of vehicular and foot traffic over the bridges and expressed its willingness to contribute the amount of Rs. 13,000.

8. The matter, however, became complicated by the decision of the Railway Company to provide an overbridge in place of the existing level-crossing in connection with the alterations to the Bezwada station yard. There was some doubt as to the exact intention of the Railway Company in the matter of the overbridges and the Agent, Madras and Southern Mahratta Railway, was accordingly addressed.

9. With his letter No. 351-W./689/10843, dated 7th May 1909, the Agent, Madras and Southern Mahratta Railway Company, forwards plans Nos. 5660/11/1 and 6161-H and the case is now clear so far as the Railway Company's scheme is concerned.

10. It will be seen that the Railway Company propose to provide a new road overbridge for vehicular traffic at the south end of the Bezwada station in place of the existing level-crossing A in plan No. 6161-H and a foot overbridge across the yard at the point marked C in plan No. 6161-H, the existing level crossings B and D on each side of the proposed foot-bridge being closed. With regard to the approaches to the proposed new overbridge at A, the Agent, Madras and Southern Mahratta Railway, proposes also the construction of a new skew bridge over the Ellore canal as shown in plan No. 5660/11/1 as well as a new bridge over the Ryves' canal.

11. Before anything further is done in the matter, the Government consider it advisable for the Superintending Engineer, II Circle, to arrange a conference with the Collector of Kistna and the Chairman of the Bezwada Municipal Council to discuss the question of the adequacy of the provision proposed by the Railway Company for vehicular and foot traffic and for navigation and to report to Government whether the scheme is considered satisfactory. The Agent, Madras and Southern Mahratta Railway Company, should also be given adequate notice of the date of meeting so that he may, if desirous, send a representative to the conference. The Superintending Engineer will make the necessary arrangements and submit a report on receipt of which further orders will be issued.

(True Extract.)

C. A. SMITH,
*Joint Secy. to Govt., P.W.D.,*
*Irrigation Branch.*

To the Chief Engineer for Irrigation, with copies of plans Nos. 6161-H and 5660/11/1.
,, Superintending Engineer, II Circle, with plans and estimate and copies of plans Nos. 6161-H and 5660/11/1.
,, Public Works Department (Railway).
,, Local and Municipal Department, with copies of plans Nos. 6161-H and 5660/11/1 and copy of Notes.
,, Collector of Kistna, with copies of plans Nos. 6161-H and 5660/11/1.
Copy to the Revenue Department, with copies of plans Nos. 6161-H and 5660/11/1.